

THE
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OR,

UNIVERSAL DICTIONARY

OF

Arts, Sciences, and Literature.

BY

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WITH THE ASSISTANCE OF

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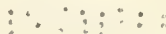
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CYCLOPÆDIA:

OR, A NEW

UNIVERSAL DICTIONARY

OF

ARTS and SCIENCES.

PUNISHMENT.

PUNISHMENT, a penalty imposed upon the commission of some crime or offence against the laws.

It is essential to the nature of a law, that it import or decree a punishment to the transgressors of it.

Solon very justly asserted, that the two great stimulants of human action being hope and fear, a good government could not possibly exist without an equitable system of rewards and punishments.

The forms and manners of punishment are various in various countries and ages, and for various crimes; as treason, felony, adultery, parricide, &c.

There was a time, says Beccaria, when all punishments were pecuniary. The crimes of the subjects were the inheritance of the prince, so that an injury done to society was a favour to the crown, and the sovereign and magistrates, those guardians of the public security, were interested in the violation of the laws. Crimes were tried at that time in a court of exchequer, and the cause became a civil suit between the person accused and the crown. The magistrate then possessed powers that were not necessary for the public welfare, and the criminal suffered punishments different from those which the necessity of example required. The judge was rather a collector for the crown, an agent for the treasury, than a protector and minister of the laws.

Among the Romans, the *pecuniary* punishments were the *multa* and *confiscatio*. The *corporal* punishments were *capitis diminutio*, *aquæ et ignis interdictio*, *proscriptio*, *deportatio*, *relegatio*, *furca*, *crux*, *carcer*, *culeus*, *equuleus*, *scale gemoniæ*, *damnatio ad gladium*, *ad metallum*, *flagellatio*, *talio*, &c. which see described under their respective articles.

Among us the principal *civil* punishments are, *fines*, *imprisonments*, *the stocks*, *pillory*, *burning in the hand*, *whipping*, *ducking-stool*, *hanging*, *beheading*, *quartering*, *burning*, *transportation*, &c.

The *ecclesiastical* punishments are, *censures*, *suspensions*, *deprivations*, *degradations*, *excommunications*, *anathemas*, *penances*, &c. The *military* punishments are, *being shot*, *running the gantelope*, *riding the wooden horse*, *the bilboes*, &c.

Among the Turks, &c. *impaling*, *bastinadoes* on the soles of the feet, &c. obtain. See **EMPALEMENT**, &c.

The right of punishing crimes against the law of nature, as murder and the like, is in a state of mere nature vested in every individual. Accordingly the first murderer, Cain, was so sensible of this, that we perceive him (Gen. iv. 14.) expressing his apprehensions, that *whoever* would find him would slay him. In a state of society, this right is transferred from individuals to the sovereign power; and thus men are prevented from being judges in their own causes, which is one of the evils that civil government was intended to remedy. The sword of justice is now vested by the consent of the whole community in the magistrate alone. Every punishment which does not arise from absolute necessity, says the great Montesquieu, is tyrannical; and this proposition is rendered more general by Beccaria, who observes, that every act of authority of one man over another, for which there is not an absolute necessity, is tyrannical. Upon this principle, the sovereign's right to punish crimes is founded; that is, upon the necessity of defending the public liberty, entrusted to his care, from the usurpation of individuals; and punishments are just in proportion, as the liberty, preserved by the sovereign, is sacred and valuable. It was necessity that forced men to give up a part of their liberty, and it is certain, that every individual would chuse to put into the public stock the smallest portion possible; as much only as was sufficient to engage others to defend it. The aggregate of these, the smallest portions possible, forms the right of punishing: all that extends beyond this is abuse, and not justice. The laws only can determine

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the punishment of crimes; and the authority of making penal laws can only reside with the legislator, who represents the whole society, united by the social compact. No magistrate, therefore, as he is one of the society, can, with justice, inflict on any other member of the same society, punishment that is not ordained by the laws, nor increase the punishment already determined by the laws. To the sovereign representing the society itself, who makes general laws to bind the members, it does not belong to judge, whether any individual has violated the social compact, or incurred the consequent punishment. In this case, there are two parties, one represented by the sovereign, who insists upon the violation of the contract, and the other is the person accused, who denies it. It is necessary then, that there should be a third person to decide this contest; that is to say, a judge or magistrate, from whose determination there should be no appeal. Judges, in criminal cases, says Beccaria, have no right to interpret the penal laws, because they are not legislators. The lawful interpreter is the sovereign, that is, the representative of society, and not the judge, whose office is only to examine, if a man have, or have not committed an action contrary to the laws. Many evils arise from the erring instability of arbitrary interpretation.

The lawfulness of punishing criminals, who are chargeable with offences against the laws of society, that are only "*mala prohibita*" and not "*mala in se*," is founded upon this principle, that the law by which they suffer was made by their own consent; it is a part of the original contract into which they entered, when first they engaged in society; it was calculated for, and has long contributed to, their own security. This right, conferred by universal consent, gives to the state exactly the same power, and no more, over all its members, as each individual member had naturally over himself or others. Hence some have doubted how far a human legislature ought to inflict capital punishments for *positive* offences;—offences against the municipal law only, not against the law of nature; since no individual has, naturally, a power of inflicting death upon himself or others for actions in themselves indifferent.

With regard to offences "*mala in se*," capital punishments are in some instances inflicted by the immediate command of God himself to all mankind, as in the case of murder, by the precept delivered to Noah, their common ancestor and representative (Gen. ix. 6.), "*whoso sheddeth man's blood, by man shall his blood be shed.*" In other instances, they are inflicted after the *example* of the Creator, in his positive code of laws for the regulation of the Jewish republic; as in the case of the crime against nature. But they are sometimes inflicted without such express warrant or example, at the will and discretion of the human legislature, as for forgery, for theft, and sometimes for offences of a lighter kind. None of these crimes are offences against nature, but only against social rights. The practice of inflicting capital punishments, for offences of human institution, is thus justified by that great and good man, sir Matthew Hale (1 Hal., P. C. 13.) "*When offences grow enormous, frequent, and dangerous to a kingdom or state, destructive or highly pernicious to civil societies, and to the great insecurity and danger of the kingdom or its inhabitants, severe punishment and even death itself is necessary to be annexed to laws in many cases by the prudence of lawgivers.*" It is, therefore, as judge Blackstone observes, the enormity, or dangerous tendency of the crime, that alone can warrant any earthly legislature in putting him to death that commits it. It is not its frequency only, or the difficulty of otherwise preventing it, that will excuse our attempting to prevent it by a wanton effusion of human blood. For, though the end of punish-

ment is to deter men from offending, it can never follow from this circumstance, that it is lawful to deter them at any rate and by any means; since there may be unlawful methods of enforcing obedience even to the justest laws. Every humane legislator, as the learned judge remarks, will be therefore extremely cautious of establishing laws that inflict the penalty of death, especially for slight offences, or such as are merely positive. Nor will it avail to allege that no lighter penalty will be effectual, because experience has not taught us that capital punishments are more effectual. Was the vast territory of all the Russias, it may be asked, worse regulated under the empress Elizabeth, than under her more sanguinary predecessors? Or has it been since, under Catharine II., less civilized, less social, and less secure? And yet we are assured, that neither of these illustrious princesses have, throughout their whole administration, inflicted the penalty of death; and the latter, upon full persuasion of its being useless, and even pernicious, issued orders for abolishing it entirely throughout her extensive dominions. But if capital punishments, says Blackstone, were proved by experience to be a sure and effectual remedy, that would not prove the necessity (upon which the justice and propriety depend) of inflicting them upon all occasions, when other expedients fail. This reasoning would, as we may justly apprehend, extend much too far. Where the evil to be prevented is not adequate to the violence of the preventive, a sovereign that thinks seriously can never reconcile laws that inflict death to the dictates of conscience and humanity. To shed the blood of our fellow-creature, says the learned and humane judge, is a matter that requires the great st deliberation, and the fullest conviction of our own authority; for life is the immediate gift of God to man; which neither he can resign, nor can it be taken from him, unless by the command or permission of him who gave it; either expressly revealed or collected from the laws of nature or society by clear and indisputable demonstration. Blackstone, however, would not be understood to *deny* the right of the legislature in any country to enforce its own laws by the death of the transgressor, though some persons of abilities have *doubted* it. To this class of persons we may refer the ingenious writer already cited. The useless profusion of punishments, which has never made man better, has induced Beccaria to enquire, whether the punishment of *death* be really just or useful in a well-governed state? What right, he asks, have men to cut the throats of their fellow-creatures? Certainly not that on which the sovereignty and laws are founded. The laws are only the sum of the smallest portions of the private liberty of each individual, and represent the general will, which is the aggregate of that of each individual. Did any one ever give to others the right of taking away his life? Is it possible, that in the smallest portions of the liberty of each, sacrificed to the good of the public, can be contained the greatest of all good, life? If it were so, how shall it be reconciled to the maxim which tells us, that a man has no right to kill himself? Which he certainly must have, if he could give it away to another. The punishment of death is not authorized by any right; for no such right exists. The death of a citizen cannot be necessary, but in one case; when, though deprived of his liberty, he has such power and connections as may endanger the security of the nation; when his existence may produce a dangerous revolution in the established form of government. But even in this case, it can only be necessary when a nation is on the verge of recovering or losing its liberty; or in times of absolute anarchy, when the disorders themselves hold the place of laws.

If the experience of all ages be not sufficient to prove, that the punishment of death has never prevented determined
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men from injuring society ; if the example of the Romans ; if twenty years reign of Elizabeth, empress of Russia, in which she gave the fathers of their country an example more illustrious than many conquests bought with blood ; if, says Beccaria, all this be not sufficient to persuade mankind, who always suspect the voice of reason, and who chuse rather to be led by authority, let us consult human nature in proof of this assertion.

It is not the intenseness of the pain that has the greatest effect on the mind, but its continuance ; for our sensibility is more easily and more powerfully affected by weak but repeated impressions, than by a violent, but momentary, impulse. The power of habit is universal over every sensible being. As it is by that we learn to speak, to walk, and to satisfy our necessities, so the ideas of morality are stamped on our minds by repeated impressions. The death of a criminal is a terrible but momentary spectacle, and therefore a less efficacious method of deterring others, than the continued example of a man deprived of his liberty, condemned, as a beast of burthen, to repair, by his labour, the injury he has done to society. " If I commit such a crime," says the Spectator to himself, " I shall be reduced to that miserable condition for the rest of my life." A much more powerful preventive than the fear of death, which men always behold in distant obscurity.

The terrors of death make so slight an impression, that it has not force enough to withstand the forgetfulness natural to mankind, even in the most essential things ; especially when assailed by the passions. Violent impressions surprise us, but their effect is momentary ; they are fit to produce those revolutions which instantly transform a common man into a Lacedæmonian or a Persian ; but in a free and quiet government they ought to be rather frequent than strong.

The execution of a criminal is, to the multitude, a spectacle, which in some excites compassion mixed with indignation. These sentiments occupy the mind much more than that salutary terror which the laws endeavour to inspire ; but in the contemplation of continued suffering, terror is the only, or at least predominant sensation. The severity of a punishment should be just sufficient to excite compassion in the spectators, as it is intended more for them than for the criminal.

A punishment, to be just, should have only that degree of severity which is sufficient to deter others. Now there is no man, who, upon the least reflection, would put in competition the total and perpetual loss of his liberty, with the greatest advantages he could possibly obtain in consequence of a crime. Perpetual slavery, then, has in it all that is necessary to deter the most hardened and determined, as much as the punishment of death :—it has even more. There are many who can look upon death with intrepidity and firmness ; some through fanaticism, and others through vanity, which attends us even to the grave ; others from a desperate resolution, either to get rid of their misery, or cease to live : but fanaticism and vanity forsake the criminal in slavery, in chains and fetters, in an iron cage ; and despair seems rather the beginning than the end of their misery. The mind, by collecting itself and uniting all its force, can, for a moment, repel assailing grief ; but its most vigorous efforts are insufficient to resist perpetual wretchedness.

In all nations, where death is used as a punishment, every example supposes a new crime committed. Whereas in perpetual slavery, every criminal affords a frequent and lasting example ; and if it be necessary that men should often be witnesses of the power of the laws, criminals should often be put to death ; but this supposes a frequency of crimes ;

and from hence this punishment will cease to have its effect, so that it must be useful and useless at the same time.

We shall be told, that perpetual slavery is as painful a punishment as death, and therefore as cruel. To which we answer, that if all the miserable moments in the life of a slave were collected into one point, it would be a more cruel punishment than any other ; but these are scattered through his whole life, whilst the pain of death exerts all its force in a moment. There is also another advantage in the punishment of slavery, which is, that it is more terrible to the spectator than to the sufferer himself ; for the spectator considers the sum of all his wretched moments, whilst the sufferer, by the misery of the present, is prevented from thinking of the future. All evils are increased by the imagination, and the sufferer finds resources and consolations, of which the spectators are ignorant ; who judge by their own sensibility of what passes in a mind, by habit grown callous to misfortune.

He who foresees that he must pass a great number of years, even his whole life, in pain and slavery ; a slave to those laws by which he was protected ; in sight of his fellow citizens, with whom he lives in freedom and society ; makes an useful comparison between those evils, the uncertainty of his success, and the shortness of the time in which he shall enjoy the fruits of his transgression. The example of those wretches continually before his eyes, makes a much greater impression on him than a punishment, which, instead of correcting, makes him more obdurate.

The punishment of death is pernicious to society, from the example of barbarity it affords. If the passions, or the necessity of war, have taught men to shed the blood of their fellow creatures, the laws, which are intended to moderate the ferocity of mankind, should not increase it by examples of barbarity, the more horrible, as this punishment is usually attended with formal pageantry. Is it not absurd, that the laws, which detest and punish homicide, should, in order to prevent murder, publicly commit murder themselves ? What are the true and most useful laws ? Those compacts and conditions which all would propose and observe, in those moments when private interest is silent, or combined with that of the public. What are the natural sentiments of every person concerning the punishment of death ? We may read them in the contempt and indignation with which every one looks on the executioner, who is nevertheless an innocent executor of the public will ; a good citizen, who contributes to the advantage of society ; the instrument of the general security within, as good soldiers are without. What then is the origin of this contradiction ? Why is this sentiment of mankind indelible, to the scandal of reason ? It is, that in a secret corner of the mind, in which the original impressions of nature are still preserved, men discover a sentiment which tells them, that their lives are not lawfully in the power of any one, but of that necessity only, which with its iron sceptre rules the universe.

What must men think, when they see wise magistrates and grave ministers of justice, with indifference and tranquillity, dragging a criminal to death, and whilst a wretch trembles with agony, expecting the fatal stroke, the judge, who has condemned him, with the coldest insensibility, and perhaps with no small gratification from the exertion of his authority, quits his tribunal to enjoy the comforts and pleasures of life ? They will say, ' Ah ! those cruel formalities of justice are a cloak to tyranny, they are a secret language, a solemn veil, intended to conceal the sword by which we are sacrificed to the insatiable idol of despotism. Murder, which they would represent to us as an horrible crime, we see practised by them without repugnance, or remorse. Let us follow their ex-

ample. A violent death appeared terrible in their descriptions, but we see that it is the affair of a moment. It will be still less terrible to him, who, not expecting it, escapes almost all the pain.' Such is the fatal, though absurd reasoning of men who are disposed to commit crimes; on whom, the abuse of religion has more influence than religion itself.

How happy were mankind, says this author, if laws were now to be formed; now that we see on the thrones of Europe, benevolent monarchs, friends to the virtues of peace, to the arts and sciences, fathers of their people, though crowned yet citizens; the increase of whose authority augments the happiness of their subjects, by destroying that intermediate despotism, which intercepts the prayers of the people, to the throne. If these humane princes have suffered the old laws to subsist, it is doubtless because they are deterred by the numberless obstacles, which oppose the subversion of errors established by the sanction of many ages; and therefore every wise citizen will wish for the increase of their authority.

It has long since been observed, says Voltaire, to whom the commentary on Beccaria's essay is attributed, that a man after he is hanged is good for nothing, and that punishments invented for the good of society, ought to be useful to society. It is evident, that a score of stout robbers, condemned for life to some public work, would serve the state in their punishment, and that hanging them is a benefit to nobody but the executioner.

There have been some judges, says this writer, who were passionately fond of spilling human blood; such was Jefferies in England, and such in France was the man whom they called *Coupe-tête*. Nature never intended such men for magistrates, but for executioners.

As to the *end*, or final cause of human punishments, this is not to be considered as an atonement or expiation for the crime committed, but as a precaution against future offences of the same kind. This purpose is accomplished in three ways; either by the amendment of the offender himself, with a view to which all corporal punishments, fines, and temporary exile or imprisonment are inflicted; or by deterring others by the dread of his example from committing similar offences, "ut pœna (as Cicero expresses it, pro Cluentio, 46) ad paucos, metus ad omnes perveniat;" or, lastly, by depriving the party who offends and injures, of the power to do future mischief, which is effected by either putting him to death, or condemning him to perpetual confinement, slavery, or exile. The method of inflicting punishment, however, ought always to be proportioned to the particular purpose it is meant to serve, and by no means to exceed it; and therefore the pains of death, and perpetual disability by exile, slavery, or imprisonment, ought never to be inflicted, but when the offender appears incorrigible.

The *measure* of human punishments must be left to the arbitration of the legislature, which should inflict such penalties as are warranted by the laws of nature and society, and such as appear to be the best calculated to answer the end of precaution against future offences. Some have recommended, and highly extolled for its equity, the "*lex talionis*," or law of retaliation; but judge Blackstone observes, that this can never be in all cases an adequate or permanent rule of judgment. Although there cannot be any regular or determinate method of rating the quantity of punishments for crimes, by any one uniform rule, applicable to all cases, and without ultimately referring to the will and discretion of the legislative power; yet there are some general principles, deduced from the nature and circumstances of the crime, that may afford some assistance in

allotting to it an adequate punishment. One circumstance that serves in some measure to determine the nature and degree of punishment regards the object of it; for the more dignified in respect of rank, character, and influence, the object of an injury is, so much greater care should be taken to prevent that injury, and of course under this aggravation the punishment should be more severe. Accordingly treason in conspiring the king's death, is by the English law punished with greater rigour than even actually killing any private subject. Moreover, the violence of passion, or temptation may, in some cases, alleviate a crime; such is theft in case of hunger, contradistinguished from the same crime committed through avarice, and to serve the purposes of luxury. Homicide, in consequence of sudden and violent resentment, is less penal than upon cool deliberate malice. The age, education, and character of the offender; the repetition (or otherwise) of the offence; the time, the place, the company in which it was committed; all these, and a thousand other incidents, may aggravate or extenuate the crime. Thus Demosthenes (in his oration against Midias) finely works up the aggravations of the insults he had received: "I was abused," says he, "by my enemy, in cold blood, out of malice, not by heat of wine, in the morning, publicly, before strangers as well as citizens; and that in the temple, whither the duty of my office called me."

Farther, as punishments are chiefly intended for the prevention of future crimes, those should be most severely punished, which are the most destructive of the public safety and happiness; and, among crimes of an equal malignity, those which a man has the most frequent and easy opportunity of committing, which cannot be so easily guarded against as others, and which, therefore, the offender has the strongest inducement to commit; according to Cicero's observation (Pro Sexto Roscio, 40); "*ea sunt animadvertenda peccata maximè, quæ difficillimè præcaventur.*"

We may also observe, that punishments of unreasonable severity, especially when indiscriminately inflicted, have less effect in preventing crimes, and amending the manners of a people, than such as are more mild or merciful in general, and yet properly intermixed with due distinctions of severity. Crimes, says Beccaria, are more effectually prevented by the *certainty* than the *severity* of punishment. The certainty of a small punishment will make a stronger impression, than the fear of one more severe, if attended with the hopes of escaping; for it is the nature of mankind to be terrified at the approach of the smallest inevitable evil, whilst hope, the best gift of heaven, hath the power of dispelling the apprehension of a greater; especially if supported by examples of impunity, which weakness or avarice too frequently afford.

If punishments be very severe, men are naturally led to the perpetration of other crimes, to avoid the punishment due to the first. The countries and times most notorious for severity of punishments, were always those in which the most bloody and inhuman actions and the most atrocious crimes were committed; for the hand of the legislator and the assassin were directed by the same spirit of ferocity; which, on the throne, dictated laws of iron to slaves and savages, and, in private, instigated the subject to sacrifice one tyrant to make room for another.

In proportion as punishments become more cruel, the minds of men, as a fluid rises to the same height with that which surrounds it, grow hardened and insensible; and the force of the passions still continuing, in the space of an hundred years, the *wheel* terrifies no more than formerly the *prison*. That a punishment may produce the effect required,

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it is sufficient that the *evil* it occasions should exceed the *good* expected from the crime; including in the calculation the certainty of the punishment, and the privation of the expected advantage. All severity beyond this is superfluous, and therefore tyrannical.

There are yet two other consequences of cruel punishments, which counteract the purpose of their institution, which was, to prevent crimes. The *first* arises from the impossibility of establishing an exact proportion between the crime and punishment, for though ingenious cruelty hath greatly multiplied the variety of torments, yet the human frame can suffer only to a certain degree, beyond which it is impossible to proceed, be the enormity of the crime ever so great. The *second* consequence is impunity. Human nature is limited no less in evil than in good. Excessive barbarity can never be more than temporary; it being impossible that it should be supported by a permanent system of legislation; for if the laws be too cruel they must be altered, or anarchy and impunity will succeed. The excessive severity of laws (says Montesquieu, *Sp. of Laws*, b. 6. c. 13.) hinders their execution; when the punishment surpasses all measure, the public will frequently, out of humanity, prefer impunity to it.

Thus also the statute 1 Mar. st. 1. c. 1. recites in its preamble, "that the state of every king consists more assuredly in the love of the subject towards their prince, than in the dread of laws made with rigorous pains; and that laws made for the preservation of the commonwealth without great penalties, are more often obeyed and kept, than laws made with extreme punishments." Happy had it been for the nation, says judge Blackstone, if the subsequent practice of that deluded princess, in matters of religion, had been correspondent to these sentiments of herself and parliament, in matters of state and government. It may be farther observed, that sanguinary laws are a bad symptom of the distemper of any state, or at least of its weak constitution. The laws of the Roman kings, and the twelve tables of the *decemvirs*, were full of cruel punishments: the Porcian law, which exempted all citizens from sentence of death, silently abrogated them all. At this period the republic flourished: under the emperors severe punishments were revived; and then the empire fell.

We may further add, that it is absurd and impolitic to apply the same punishment to crimes of different malignity. Besides, a multitude of sanguinary laws (besides the doubt that may be entertained concerning the right of making them) proves likewise a manifest defect either in the wisdom of the legislative, or the strength of the executive power. Although it be much easier to extirpate than to amend mankind; yet that magistrate must be esteemed both a weak and a cruel surgeon, who cuts off every limb, which through ignorance or indolence he will not attempt to cure. Beccaria therefore proposes to form in every state a scale of crimes, with a corresponding scale of punishments, descending from the greatest to the least; but if this idea be deemed romantic, a wise legislator will at least mark the principal divisions, and not assign penalties of the first degree to offences of an inferior rank. When men see no distinction made in the nature and gradations of punishment, the generality will be led to conclude, there is no distinction in the guilt. Much as we may be disposed to admire and extol the excellence of the English law in a variety of respects, yet none can otherwise than regret the frequency of its capital punishments; inflicted by a multitude of successive and independent statutes, upon crimes very different in their natures; and we cannot forbear paying our tribute of respect to sir Samuel Romilly, whose talents and character

far exceed our praise, and other legislators, who are laudably exerting themselves in simplifying and mitigating our penal code.

It is a melancholy truth, says judge Blackstone, that among the variety of actions, which men are daily liable to commit, no less than 160 have been declared by act of parliament to be felonies without benefit of clergy; or in other words, to be worthy of instant death. So dreadful a list, instead of diminishing, increases the number of offenders. The injured, through compassion, will often forbear to prosecute: juries, through compassion, will sometimes forget their oaths, and either acquit the guilty or mitigate the nature of the offence; and judges, through compassion, will respite one half of the convicts, and recommend them to the royal mercy. Among so many chances of escaping, the ready and hardened offender overlooks the multitude that suffer; he boldly engages in some desperate attempt, to relieve his wants or supply his vices; and if, unexpectedly, the hand of justice overtakes him, he deems himself peculiarly unfortunate, in falling at last a sacrifice to those laws, which long impunity has taught him to contemn.

Beccaria, whose excellent essay we have often cited in this article, observes, that the more immediately after the commission of a crime, a punishment is inflicted, the more just and useful it will be. It will be more just, because it spares the criminal the cruel and superfluous torment of uncertainty, which increases in proportion to the strength of his imagination, and the sense of his weakness; and because the privation of liberty, being a punishment, ought to be inflicted before condemnation, but for as short a time as possible. Imprisonment, he says, being only the means of securing the person of the accused, until he be tried, condemned, or acquitted, ought not only to be of as short duration, but attended with as little severity as possible. The time should be determined by the necessary preparation for the trial, and the right of priority in the oldest prisoners. The confinement ought not to be closer than is requisite to prevent his flight, or his concealing the proofs of the crime; and the trial should be conducted with all possible expedition. Can there be a more cruel contrast than that between the indolence of a judge, and the painful anxiety of the accused; the comforts and pleasures of an insensible magistrate, and the filth and misery of the prisoner? In general, "The degree of the punishment, and the consequences of a crime, ought to be so contrived, as to have the greatest possible effect on others, with the least possible pain to the delinquent." If there be any society in which this is not a fundamental principle, it is an unlawful society; for mankind, by their union, originally intended to subject themselves to the least evils possible.

An immediate punishment is more useful; because the smaller interval of time between the punishment and the crime, the stronger and more lasting will be the association of the two ideas of *crime* and *punishment*; so that they may be considered, one as the cause, and the other as the unavoidable and necessary effect.

It is, then, of the greatest importance, that the punishment should succeed the crime as immediately as possible, if we intend, that in the rude minds of the multitude, the seducing picture of the advantage arising from the crime, should instantly awake the attendant idea of punishment. Delaying the punishment serves only to separate these two ideas; and thus affects the minds of the spectators rather as being a terrible sight, than the necessary consequence of a crime; the horror of which should contribute to heighten the idea of the punishment.

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PUNISHMENT.

There is another excellent method of strengthening this important connection between the ideas of crime and punishment; that is, to make the punishment as analogous as possible to the nature of the crime; in order that the punishment may lead the mind to consider the crime in a different point of view, from that in which it was placed by the flattering idea of promised advantages. This ingenious writer closes his essay with the following general theorem, as the result of his previous reasoning. "That a punishment may not be an act of violence, of one or of many against a private member of society, it should be public, immediate, and necessary; the least possible in the case given; proportioned to the crime, and determined by the laws." *Montesqu. Sp. of Laws. Beccaria's Essay on Crimes and Punishments. Blackst. Com. vol. iv.*

A valuable work, comprising the subject of this article, was presented to the public in the year 1811 by M. Dumont of Geneva. It was formed of detached materials, furnished by the papers of Mr. Jeremiah Bentham, and the whole is executed with such judgment in the arrangement of the matter, and so much liveliness and elegance as to the style of the composition, that M. Dumont appears more like an original author than an editor. This work would have afforded us many instructive and interesting extracts, if our limits had allowed our making that use of it, which it deserves. This, however, is the less necessary, as the reader may have access to the original treatise, *viz.* "Theorie des Peines et des Recompenses; par M. Jeremie Bentham, Jurisconsulte Anglois; redigée in François d'après les Manuscrits, par M. Et. Dumont de Genève," 2 vol. 8vo. à Londres, 1811: or to the ample analysis of it in the *Edinburgh Review*, N° 43. A brief account of its contents may, however, be gratifying to our readers. This work consists of two great parts or branches; the theory of penal legislation, and the theory of remunerative legislation. The first contains in a systematical form all the principles that serve to regulate the choice of different modes of punishment and the apportionment of punishments to crimes. In the second are exhibited the principles upon which the lawgiver ought to proceed, when he holds out inducements either alone or attended with corresponding penalties, to influence the conduct of his subjects. The first book explains the general principles of the system, and opens with definitions and classifications.

Punishment, in its most general sense, is the infliction of some evil upon an individual, with an intention that he should suffer this evil, and with a reference to some act done or omitted. Punishment, in its legal sense, is the infliction of some evil, according to judicial forms, upon an individual convicted of some act forbidden by law, and with the intention of preventing the recurrence of such acts. Punishments, as well as crimes, are divisible into four classes, as they affect the *person*, the *property*, the *reputation*, or the *condition* of those upon whom they are inflicted. Those which affect the person, or corporal punishments, are subdivided into various species; they may be simply or complexly afflictive, or restrictive, or active (*e. g.* compulsory labour) or capital. The other three classes are all privative, affecting the delinquent with loss or degradation. Hence arises another general classification of punishments, by dividing them into corporal and privative.

From this definition it appears, that the object of all punishment is the prevention of the offence in future, either by the same delinquent or by other persons in similar circumstances. The first end is accomplished in three ways; by taking from the offender the physical power of committing the offence; by taking away the desire; or by deterring

him. The other, and principal object of the infliction, that of restraining others, can only be effected as far as the punishment is concerned, by the threat which it holds out of similar infliction. These objects, as they form the only just motives, constitute also the only justification of punishments. Although the direct and primary object of punishment is prevention, the civil magistrate, having provided for that object, has another duty to perform, which is to provide as far as possible for the reparation of the injury sustained through the crime committed.

The *expence* or *cost* of any punishment is, in the language of this system, the whole evil of every kind occasioned by it, including the suffering of the delinquent, the loss of his labour or life to the state, the pecuniary cost of his punishment; and, in short, every thing endured, paid, or foregone, in order to obtain the double preventive which the punishment is intended to administer. The *gain* or *profit* of the punishment consists in this preventive, or in the tendency of the punishment to secure it. A punishment may be termed frugal or economical which produces the desired effect with as little suffering as possible; and it may be termed costly or prodigal, when the same effect might have been produced by a smaller degree of suffering. The *real value* is distinguished from the *apparent value*, of the suffering; the former being the actual amount of that which is inflicted; the latter, the portion of it which is exhibited, or otherwise made known to, and understood by the public. The expence of a punishment is equivalent to the real amount; the profit is in proportion to the apparent only; and hence are deduced these important maxims: 1. That, *ceteris paribus*, a punishment easily comprehended, is preferable to one of difficult apprehension: 2. That one which takes hold of the memory, is preferable to one easily forgotten: 3. That one which is as great or greater in apparent than in real amount, is preferable to one which is really greater than it appears to be:—the excess of real amount being in truth so much thrown away, so far as regards the principal object, of general example.

The next subject of discussion comprehends the principles that ought to regulate the extent of punishment, for the prevention of crimes. These are contained in the following propositions. 1. The evil of the punishment must exceed the advantage arising from the crime; so that, generally speaking, the stronger the temptation to commit any crime, the more severe ought to be the punishment, subject to exceptions in extreme cases. 2. When the criminal act evidently indicates a habit or practice, the punishment should be proportioned, not to the gain derived from a single offence, but to the probable amount of profit flowing from a course of such conduct. 3. An addition must be made to the punishment, in order to compensate its want of certainty and proximity. 4. In cases where a temptation offers for the commission of different crimes, a more severe punishment should be denounced against the greater crime. 5. The more pernicious any crime is, the more safely may a severe punishment be ventured upon, for the chance of preventing it. 6. The nominal amount of punishment for the same crime, must often be varied at the discretion of the judge, according to the circumstances of the delinquent, in order to preserve the real amount of suffering.

The qualities of punishment, the consideration of which naturally succeeds that of the measure or quantity, are such as follow: it should be *divisible*; *invariable*, or *certain* or *equal*; *commensurable* with others; *analogous* to the crime; *exemplary*; *economical*; *remissible*; that it should restrain the offender from doing harm; conduce to his *reformation*; yield a *profit*, in the ordinary sense of the word; be *simple* in its description;

description; and so far *popular* as to shock none of the established feelings or prejudices of the community. These qualities are, for the most part, understood as soon as they are mentioned. Some of them, however, undergo a more ample discussion than others. This is the case with respect to the qualities of *analogy* and *popularity*. One of the sources of analogy specified by Mr. Bentham is that of employing the same instrument or operation in the punishment, as the delinquent did in the crime, as, *e. gr.* burning an incendiary who had committed any aggravated act of *arson*, by which lives were sacrificed as well as property. Another method is that of inflicting on the delinquent the same injury which he offered to the innocent person. A third consists in subjecting to punishment the part of the body with which the offender committed the crime. A fourth, in affecting the face with some disfigurement similar to disguising, where part of the offence was the use of a disguise. Other analogies also are enumerated. In discussing the *popularity* of punishment, the author adverts to the prevalence of false feelings and prejudices, and he reduces the errors proceeding from these causes to four heads; as they consist in mistaken notions of *liberty*, *decency*, *religion*, and *humanity*. The author allows, however, that a lawgiver should, for a time at least, frame his institutions so as to humour even the caprices and errors of his people, when he finds them too deeply rooted and widely spread, to be overcome or disregarded. To any speculative arguments, founded upon false views of those different subjects, of course no regard should be paid;—as to those fanatics in politics, religion, or sentiment, who would have no imprisonment because it violates liberty, or abolish capital punishments because they encroach upon the province of the Deity, or because they are painful to the feelings.

The author mentions four cases, in which punishment is wholly inept, and ought not to be inflicted; *viz.* where the crime being either imaginary, or unfit for legislative interference, may be said not to exist, and the punishment would be *unfounded*: where the punishment would be wholly *inefficacious* on the delinquent, or others in the same circumstances, as in the case of idiots: where the means being sufficient to accomplish the end in view, punishment would be *superfluous*: where more evil being likely to result from punishing the particular offenders than from letting them escape, the infliction would be too *costly*, as in the case of an extensive mutiny or rebellion.

We have already stated, that the author divides punishments into two great classes, *corporal* and *privative*; that he again subdivides corporal punishments into five kinds, and privative into three. 1. The *first* class of corporal punishments consists of punishments *simply afflictive*, denoting those which cause bodily suffering, with little attendant injury; and even those most simple, as the lash, are accompanied with a certain disgrace by their public exhibition, which is an essential part of the process. Of the various kinds of simple infliction, our author gives the preference to the lash, under certain modifications. 2. The *second* class consists of punishments *complexly afflictive*, or those in which the mere bodily suffering is attended with, or followed by, some other loss, either of personal comfort or reputation. These are subdivided into three kinds, comprehending those that are inflicted by *deforming* the person, which is done either by *discolouring*, *e. gr.* burning in the hand; or *disfiguring*, *e. gr.* slitting the nose, or cutting the ear; by *disabling* a limb or organ, without destroying it; by *mutilating* or destroying the part. The *third* class comprehends *restrictive* punishments, which prevent the offender from doing or enjoying something agreeable or useful to him. The *restrictions* thus

imposed are of two kinds; *simple* prohibitions, and restraints upon *loco-motion*. The former are so limited in their application, that we need not particularly specify them; but the latter are divided into five kinds; *viz.* *imprisonment*, in the ordinary sense of the word; *quasi-imprisonment*, or confinement within the district to which the offender belongs: *relegation*, or confinement to some other district within the dominions of the state: *local interdiction*, or banishment from a particular district: *banishment* from the territories of the state, either indefinitely, or to some specific foreign part. *Imprisonment*, according to our author's statement, in order to be effectual, ought to place the offender, for a limited time, under the most complete restraint, instead of being long and slight. Mr. Bentham enlarges in the enumeration of the evils comprehended under this mode of suffering, of which some belong *inseparably* and necessarily to it; others such as are *accessory*, but most frequently accompany it; and others again such as arise from *abuses* of it. With imprisonment, he says, in certain cases, and always for a very limited time, may most advantageously be joined *solitude*, *darkness*, and *regimen*. Our author, having exposed the absurd system of "prison-fees," infers from his general principles that there ought to be three kinds of prison, adapted to the several purposes of *simple* detention, *penitentiary* confinement, and *perpetual* imprisonment. The first being only applicable to the case of insolvent debtors guilty of imprudence or extravagance, and of accused persons kept for trial, should have no accompaniment whatever of rigour. The leading principle in distinguishing the two others is, that the subjects of the former are to enter again into society; while those of the latter, being for ever excluded from it, the exemplary nature of their sufferings should be the principal object of attention. The names of the three prisons, for these separate purposes, should be different, as well as their external appearance; and every thing which can seize hold of the imagination, without awakening sympathy, should be presented, both in the construction of the perpetual prison, and in the situation of its inhabitants. 4. The *fourth* class of punishments comprehends those that are termed *active* or *laborious*. Punishments of this class, when examined by the rules already premised, are found to unite the greatest number of advantages with the fewest defects. In the discussion of this subject, the author directs our attention to what may be called the extreme case of mismanagement in this kind of punishments. Here he alludes to Botany Bay. The transportation of convicts to America, which preceded the present plan, with several disadvantages of great moment, was, upon the whole, infinitely preferable. It was grossly unequal, inasmuch as it became servitude with exile to the poor, while it was only simple relegation to those who could pay for their passage. It was defective too in preventive power, the opportunities of escape being necessarily great. In both these particulars, the deportation now practised has the manifest advantage. All the convicts are equally under restraint, and their escape is much more difficult; but in every other point of view, it is either as bad, or a great deal worse. It is as little as possible exemplary: the disproportion between the real and apparent suffering,—the excess of the former,—is in truth a maximum. The community in this country see a convict sent on a long voyage, to a fertile country, lying in a fine climate. This is the example. The reality is, that the miserable wretch, after rotting in the hulks for a year or two, is crammed with some hundreds of his fellows into a floating prison, or, it may be, a pest-house, in which, if he survives the risks of famine, pestilence, mutiny, fire, shipwreck, and explosion, he is conveyed, through the in-

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fiction of a ten months' voyage, to a life of alternate slavery and rebellion, where guilty or cruel excess succeeds exquisite suffering, without varying the uniform misery, or changing the prevalent character of the body; and all this passes at the opposite extremity of the earth's diameter, from whence it operates no more in any manner of way upon the inhabitants of England, than if it were passing in the moon. The tendency of discipline in the colony to reform the convicts, supposing them to have arrived there, may easily be estimated. They are not separated from their companions in guilt; they have no better examples before them, no eyes to watch them. The partial historian of the rising settlement, himself the chief magistrate, (Mr. Collins,) has supplied us with the details; and, in spite of his inclination to see every thing in the fairest light, he has painted, if the pages of a journal for sixteen years may be said to paint, by far the blackest picture ever yet exhibited of human society. His book is a catalogue of crimes; it would be a record of convictions, but that perjury so universally prevails as to ensure the escape of all who are not taken in the fact. The vice at the root of all the rest, a rage for spirits approaching to frenzy, can neither be cured, nor deprived of gratification. Far from improving by their residence there, it was only at the first establishment that any remission of unfavourable symptoms appeared. As soon as the first convicts had finished their period of servitude, their liberty brought along with it an influx of disorder and contamination, which each succeeding year seems to increase. If this system, then, prevents the delinquent from repeating his crimes, it is only by transferring the scene of them to a distant settlement, where it fosters and augments them; and although, with reference to one part of the empire, this may be termed prevention, the legislator, whose care should embrace the whole, has no right to give it such a name. As to the pecuniary expence, by which so much evil is purchased, we find it in the parliamentary reports estimated at above a million in about ten years, or about thirty-eight pounds for each convict, besides the value of his labour. Last of all, the punishment inflicted is perfectly different from the one to which the sentence of the law has condemned the convict. Not to mention the detention before transportation, and the arrival sometimes when the term of punishment has nearly expired, the power of returning at its expiration is possessed by few men, and no women; while of the voyage some idea may be formed, from the average mortality between 1787 and 1795, being above one in ten; and from a jail fever, always a probable occurrence, on one occasion, in 1799, having carried off one hundred in three. If, in such a case, we could look to the settlement as a colonial speculation, we should find its gains in a similar proportion; but this estimate would be as superfluous after what has been said, as it would be foreign to the design of this inquiry.

In the work before us we have a general sketch of the author's plan of improvement upon this system, together with a view of its connection with the principles which he has unfolded, and of the prodigious advantages accruing from it. The "Panopticon" is distinguished by three leading properties. From the form of the building, and the disposition of the cells, the inspector can see each prisoner at all times, without being seen by them, and can direct them without leaving his post: the management of the establishment is carried on by contract, the government paying a fixed price for the whole expences of each convict, and the contractor having the whole profit, as he has the entire charge and regulation, of the work to be performed, but allowing a certain proportion of the gain to the convict:

the contractor insures the lives and safe custody of the convicts; he is allowed yearly a certain sum for the deaths, as calculated from the common tables, and he pays the same sum for each death which actually does happen, and for every escape which takes place. If we mistake not, Mr. Bentham, by his contract with government, further engaged to pay so much for each prisoner who, after his discharge, should afterwards be convicted of any offence. The entire publicity of his accounts was another condition, and one upon which he himself insisted. The Panopticon was to be open at all times to every magistrate, and at certain hours to the public generally.

The most striking points of the comparison between both systems, as they are presented to us by the anonymous author of the article on the subject in the *Edinburgh Review*, are such as follow. The punishment is in the highest degree exemplary; it is all seen and understood; it appears much greater than it really is; the comforts of the convicts, in their intercourse with each other according to their improvement, and in the state of industry, and cleanliness, and wholesome regimen, for which they have exchanged their ordinary habits, being, however real, by no means such as strike the multitude of spectators, who only see confinement, compulsory labour, and ignominy. The reforming effects of the plan are equally manifest: the labour, to which they are in part allured by a fixed allowance of profit; the perfect temperance in which they live; the facility afforded of separating them into classes, according to their habits and behaviour; the means of easy instruction, both religious and other, which they give; all furnish as good a chance of reclaiming those unhappy persons who are not hardened in guilt, as from any such discipline can reasonably be expected. The preventive powers of the Panopticon are complete, while the convict remains in it; and although a relapse after liberation can only be guarded against by reformation, a contrivance is added to this establishment, admirably calculated to provide against the first dangers of the discharge: the convict is transferred to another place of mitigated confinement, where he is rather under inspection than in custody, and from whence he is gradually allowed wholly to withdraw. With respect to the cost of the plan, we may form some estimate of it from the terms of Mr. Bentham's contract. Each convict was to cost government 13*l.* 10*s.*, including 1*l.* 10*s.* for the proportion of the expences of building and ground. He was to provide a fund for indemnifying the parties injured; to allow the convicts one quarter of the profits of their labour; and, after the first trial, to make a reduction in the charge. Practical men, well versed in such matters, had no doubt that a very considerable reduction might have been speedily afforded; and that, in a few years, the profits would entirely defray the expences of the establishment to the state. While all manner of delays and difficulties were thrown in the way of this experiment; while wits and jobbers, or, as they termed themselves, matter-of-fact men, averse to theories, and deprecating novelties, were employed in running it down; trials were made in America of penitentiary houses upon similar principles, though in a much less perfect shape, and without some of Mr. Bentham's chief improvements. We have the most irrefragable testimony borne to their success, by the interesting narratives of the duc de Rochefoucault Liancourt and captain Turnbull: the one a person eminently skilled in the subject of prisons; the other a mere practical observer, imbued with no knowledge beyond that of the naval profession. Both these very different witnesses concur in their statement of the salutary consequences of the plan; and if we wished to find a perfect contrast to the melancholy

melancholy narratives of Mr. Collins, we could certainly nowhere so well be suited as in the descriptions which the French and English travellers have given us of the convicts in New York and Philadelphia.

5. Capital punishments compose the *fifth* class. This class consists either of *simply* inflicting death with the least possible degree of suffering, or in accompanying the destruction of life with *torments*. The latter method, at one period universally prevalent, and still known in most countries, is happily almost abolished in the two most civilized nations. In France, the Code Napoleon allowed it only in the cases of parricide, and attempts against the sovereign's life, where the addition made to the punishment of death is cutting off the right hand. In England, it is only in the case of high treason that such augmentations are allowed: the punishment of the law is no doubt barbarous in the extreme, but in practice it is always remitted. All such cruelties have the effect of inspiring pity in the spectators towards the criminal, and of rendering criminals more hardened and savage.

The ingenious author of the critique on Mr. Bentham's theory, to whose analysis of the work we are so much indebted in the compilation of this article, agrees with him in his objections to Beccaria, who maintains that a punishment of longer duration is more terrible to the spectator. Clearly there is none so dreadful as death. M. Dumont adds, that its apparent suffering is greater than its real, which applies only to the pains of it. On the other hand, it exceeds all others in some material defects; not only is it expensive, and beginning to become unpopular; it is quite irremissible, and it is in the highest degree unequal, and incapable of division or apportionment. A very satisfactory statement is given under this head, of the evil tendency of frequent executions, of the kind of reasoning by which offenders at the moment of temptation get rid of the fear of death, and especially of the wide difference between encountering certain destruction, and yielding to impulses which may lead to it. The evils arising from its being irremissible are also ably expounded; yet we think the author has neglected to consider how much of its horror consists in this quality. It is manifest that no other punishment can utterly exclude hope. In comparing capital with other punishments, our author is disposed to give the latter the preference, almost to the exclusion of the former; chiefly because, however exemplary to men in general the infliction of death may be, and how deep soever the impression it makes on their minds, it has not the same terrors for the class of men most likely to commit the worst offences, violent spirits and hardened delinquents. That its range should be extremely limited, we are willing to admit; but we differ from him in the position, that for this class of men, perpetual confinement to hard labour would have more terrors than death. The total extinction of life, without chance of escape, pardon, or mitigation, ought still to be denounced against the worst offences; and, by being confined to these, will unquestionably become doubly terrible. The evils arising collaterally from the abuse of this punishment, are so ably pointed out by sir Samuel Romilly, that our author abridges a part of the treatise before us, by referring to his tract.

The other great division of punishments in Mr. Bentham's theory, consists more peculiarly in *privation*. These may be arranged in three classes, as they impose a forfeiture of *reputation*, of *property*, or of *condition*. 1. Punishments which affect a man's reputation consist of appeals to public opinion, and are those measures which the lawgiver takes with respect to him, for directing that opinion

against him. The lawgiver may inflict punishments of this kind, or rather may expose the offender to have them inflicted, either by simply *denouncing*, with the authority belonging to his functions, that certain acts shall be deemed infamous, or by treating the particular offender *judicially* in a certain way. The latter is the mode used in modern times; and it is practised in different ways; by *publication* of the offence;—by *judicial admonition*;—by inflicting *punishments* of the other classes, corporal as well as privative, the immediate object of which is not the destruction of reputation;—by inflicting what may be termed *quasi-corporal* punishments, the sole object of which is infamy;—by *degradation*, or depriving the offender of his rank, natural or conventional;—by *discrediting* him, or preventing his testimony from being received. 2. The description of punishments affecting property consists of those which are *pecuniary*, and which are *quasi-pecuniary*, as confiscation of lands, &c. 3. The forfeiture of condition, or *status*, though a class of great extent, theoretically speaking, is in practice reduced within narrow limits. Marriage may be dissolved; children may be ballardized; blood may be corrupted; the different kinds of trust may be taken away; a person may be reduced to slavery; a community may be deprived of its rights and privileges. Outlawry may also be referred to this head.

There are other kinds of infliction, which every sound principle teaches us to avoid where it is possible, and to diminish as much as possible, where, from the defects of all human contrivances, they inevitably mingle themselves with the legitimate modes of punishment. Our author's system arranges them in two classes; those which are *misplaced*, or which fall upon other persons than the offender; and those which are *complicated*, or present neither to the legislator, the judge, the party, nor the public, any fixed and definite idea. Those punishments that are misplaced, in the proper use of the term, or which the legislator enacts with the intention of punishing another person than the offender, either along with him, or in his place, consist of four kinds; *viz. vicarious*, where the offender escapes;—*transitive*, where an innocent person is purposely punished who is connected with the offender;—*collective*, where a body of innocent persons suffer, in the presumption of the guilty being among them;—and *fortuitous*, where an innocent person suffers as well as the offender, though unconnected with him. The only instance of *vicarious* punishments is that inflicted upon the families and creditors of suicides by the law of England. This, like all other absurd and unjust laws, is evaded, in almost every instance, by perjury, and the exercise of discretion in a sovereign. The example given of *transitive* punishment is the corruption of blood, the absurdity of which is ably exposed. The chief instances of *collective* punishments are those in which corporations are punished for the faults of certain individual corporations; a proceeding which can never be justified. The well-known examples of *fortuitous* punishments are taken from the law of England. The most notable is the forfeiture and escheat of freehold property, in cases of attainder of treason and felony, where the confiscation relates back to the commission of the offence, and all mesne conveyances are avoided; so that a man may commit a secret crime, and sell his estate to an ignorant and innocent purchaser, in whose hands the crown or the lord afterwards seizes the estate upon the vendor's attainder; and as his goods and chattels are forfeited upon conviction, the only fund of compensation is gone also. Deodands are another instance of similar injustice; and the punishment of incapacitating a person from giving evidence, is manifestly one which may

strike more injuriously at parties wholly unconnected with the offender, than at himself; besides, that it is by no means inflicted merely with the view of putting courts of justice on their guard against admitting a bad witness; for it is often the punishment of crimes which have no peculiar connection with violation of truth.

Among the evils of complicated punishments, we may reckon, besides outlawry and incapacitation of giving evidence, *excommunication* and *felony*. Some gross abuses having occurred in the infliction of the punishment of excommunication, several distinguished persons have undertaken to substitute other procedure in its place; and sir W. Scott brought a bill into parliament with this view, so that the evil is done away. The punishment of persons as felons, comprehends a number of inflictions very different from each other, so that our author considers the punishing as a felon to be a vague and indefinite term. This comprehends two descriptions of punishment; the one capital, with forfeiture of lands and chattels; the other not capital, but consisting in forfeiture of chattels, and the form of burning in the hand; to which, by special enactment, imprisonment, transportation, or indeed any other punishment, may be superadded. It must be acknowledged, that a much simpler and better manner of stating the punishment due to an offence would be, to tell at once of what it is to be composed; and instead of enacting that certain offences are felonies, which specifies nothing, to prohibit them, and state the precise inflictions which shall follow the commission of them. For the general character and high commendation of the work, which has furnished the preceding materials, we refer to the *Edinh. Rev.* N° 43. p. 1—31.

PUNISHMENT, in *Theology*. It has been disputed among divines, whether the punishment of the wicked in a future world be strictly eternal or not. For the arguments on both sides of the question, see **HELL**.

PUNITORY INTEREST, in the *Civil Law*, such interest of money, as is due for the delay of payment, breach of promise, &c.

PUNK, in *Natural History*, the inward part of the excrecence or exuberance of an oak. It is used by the Indians in Virginia for medicinal burning, as the East Indians use *moxa*. *Phil. Transf.* No. 454. sect. 1.

PUNN. See **PUN**.

PUNO, in *Geography*, a town of Peru, now annexed to the viceroyalty of La Plata or Buenos Ayres, and capital of a district of the same name, called also *Paucarcolla* (not *Paucarcotta*, as it is misprinted in that article). It is a rich and populous town, situated on the W. side of the lake Titicaca, and containing some illustrious families, as well as a beautiful church for the Spaniards, and another for the Indians, who weave great quantities of coarse cloth, with which they supply the neighbouring countries. S. lat. 16° 20'. W. long. 70° 26'.

PUNT, in *Sea Language*, a sort of oblong flat-bottomed boat, with a square head and stern, whose floor resembles the platform of a floating stage; and used by shipwrights for breaming, canking, or repairing a ship's bottom. It is also used in some canals.

PUNTA, in *Geography*, a town of South America, in the audience of Quito, and jurisdiction of Guayaquil.

PUNTA, *La*, a town of Mexico, in the province of New Biscay; 40 miles N.N.E. of Durango.

PUNTA is also an epithet, distinguishing several capes, which are too numerous to be here recited; and this is the less necessary, as the principal of them occur under other appropriate titles.

PUNTA Entornada, a town on the N. coast of Spain. N. lat. 43° 34'. W. long. 5° 30'.

PUNTA del Guda, a sea-port and capital of St. Michael, one of the Azores, defended by a castle.

PUNTA de Tordera, a town and cape of Spain, on the coast of Catalonia. N. lat. 41° 38'. E. long. 2° 37'.

PUNTO del Monte, a town of South America, in the province of Cordova; 15 miles S. of Cordova.

PUNUGGA, a village of Bootan, situated in a deep hollow, and surrounded with mountains, for the most part covered with pines, along whose sides clouds are perpetually hovering. On the borders of this village are many large heaps of fir-leaves, which being left to ferment and rot, are used as excellent manure.

PUNUNAGUR, a town of Bengal; 10 miles W. of Nattore.

PUNWARY, a town of Hindoostan, in the circar of Gohud; 18 miles E. of Raat.

PUOLANGO, a town of Sweden, in the government of Ulea; 40 miles S. of Cajana.

PUPA, in *Natural History*, a name lately substituted in the room of chrysalis or aurelia, because many insects in this state resemble an infant in swaddling clothes; and all, except those of the hemiptera order, take no nourishment. See **ENTOMOLOGY**.

PUPIGLIO, in *Geography*, a town of Etruria; 10 miles N. of Pistoia.

PUPIL, **PUPILLUS**, in the *Civil Law*, a boy or girl not yet arrived at the age of puberty, i. e. under fourteen years of age for the boy, and under twelve for the girl.

While a minor remained under the direction of a tutor, he was called a pupil; after puberty, a curator being assigned him, he ceased to be called a pupil.

A tutor is obliged to pay interest for what monies of his pupil lie idle and unemployed. A tutor is allowed to do any thing for his pupil, but nothing against him.

PUPIL is also used by way of extension, in *Universities*, &c. in the sense of *alumnus*, for a youth under the education or discipline of any one.

PUPIL, in *Anatomy*, the round opening in the iris, by which the rays of light are admitted into the eye. See **EYE**.

PUPIL, in *Optics*. It is observed, that as we are forced to use various apertures to our optic glasses, so nature has made a like provision in the eyes of animals, whereby to shut out too much, and admit sufficient light, by the changes in the aperture of the pupil.

The structure of the uvula and iris is such, as that, by their aperture, the pupil is contractible and dilatable at pleasure, so as to accommodate itself to objects, and to admit more or fewer rays, as the object, being either more vivid and near, or more obscure and remote, requires more or less light: it being a constant law, that the more luminous the object, the smaller the pupil; and again, the nearer the object, the smaller the pupil; and *vice versa*.

This fact has been long ago noticed by optical writers. B. Porta, about the middle of the sixteenth century, in his treatise *De Refractione*, p. 74, observes, that the pupil is contracted involuntarily when it is exposed to a strong light, and opens of itself when the light is small. A similar observation was made by his countryman and contemporary, Father Paul of Venice. Galen, indeed, first observed the dilatation of the pupil of one eye, when the other was shut or lost, and the contraction of it, when the other was opened or recovered; and in this opinion he was followed by all naturalists and philosophers, till Fabricius ab Aquapendente, professor at Padua, by observing the eye of a cat, found

found that the pupil not only dilated and contracted itself, when one of the eyes was shut, but also when both were open. F. Paul found, from repeated experiments, that the pupil not only of cats, but also of men, and other animals, always contracted itself when the eye was exposed to a bright light, and again dilated itself when the light was faint and languid. This he always observed, as well when both eyes were open, as when one of them was shut. The same remark had been made by Achillinus, in a treatise published in 1322; and the fact was known to the Arabians, Rhazes and Avicenna. That the pupil of the eye is enlarged, in order to view remote objects, and that it is contracted while we are viewing those that are near, is a fact with which Scheiner, in the beginning of the seventeenth century, was well acquainted, and which he proved by experiments, and illustrated by figures. When a needle, or any small object, is brought near to the eye of any person, who looks attentively at it, the pupil, he says, is plainly seen to contract; and it as constantly expands whenever it is withdrawn.

This alteration of the pupil is effected by certain muscular fibres on the outside of the uvea, which arrive from nerves detached hither from the sclerotica. These fibres proceeding straight from their origin towards the centre, terminate in the orbicular limb or verge of the pupil, which consists of orbicular fibres, whereby the figure and space of the pupil are defined. The first, or longitudinal fibres, dilate the aperture of the pupilla; the latter, or orbicular ones, constrict it.

Some authors, however, attribute the motions of the pupilla to the ligamentum ciliare; and others think, that both this, and the fibres of the uvea, concur herein. Dr. Derham adds, that while the pupil opens and shuts, the ligamentum ciliare dilates or compresses the crystalline, and brings it nigher to, or farther from, the retina, as the object is more or less remote.

There is no doubt that the change to which the pupil is subject is the effect of light upon the eye. Dr. Hartley, *Obs. on Man*, vol. i. p. 219, supposes, that the light which enters at the pupil has great efficacy in contracting both the greater and less rings of the iris, as may be concluded, he says, from the immobility of the pupil in a gutta serena; also because, on this supposition, the light which passes in at the pupil mult, by contracting the less ring, become a check and guard against its own too free admission, which is agreeable to the tenor of nature in like instances. The retina, he observes, extends to the greater ring, and may send some nervous fibres to it, and even to the iris. Dr. Whytt also says, *Essay on vital and involuntary Motion*, p. 112, that the contraction of the pupil is not performed by the action of light upon the iris, but upon the retina; since whatever intercepts the rays of light, so as to prevent their reaching the retina, causes a preternatural dilatation of the pupil; because in a cataract, where the crystalline humour, being considerably opaque, intercepts a great part of the rays, the pupil loses a good deal of its contractile power. This author also observes, that the wideness of the pupil in a syncope, apoplexy, and confirmed gutta serena, shews that, in order to dilate the pupil to its largest size, no effort of the mind is necessary, but only the superior contractile power of the longitudinal fibres of the uvea, when its circular muscle is not excited into action by the stimulus of light on the retina. M. Mery informs us (*Mem. Ac. Paris*, for 1704) that, having plunged a cat in water, and exposing her eye to the strong light of the sun, the pupil was not at all contracted by it; whence he infers, that the contraction of the iris is not produced by the action

of the light, but by some other circumstance. For he contends, that the eye in this situation receives more light than in the open air. M. de la Hire, in reply, endeavours to shew, (*Mem. Ac. Par.* for 1709) that fewer rays enter the eye under water, and that, in those circumstances, it is not so liable to be affected by them. Besides, it is obvious to be remarked, that the cat must be in great terror in this situation; and being an animal that has a very great voluntary power over the muscles of the iris, and being now extremely attentive to every thing about her, she might have her eyes open, notwithstanding the action of the light upon it, and though it might be very painful to her.

The figure of the pupil, in various animals, is wonderfully adapted to their various circumstances and occasions. In some, *e. gr.* in man, it is round, that form being fittest for the position of our eyes, and the various uses we make of them in all directions.

In others, it is elliptical or oblong: in some of which, *e. gr.* the horse, sheep, ox, &c. the ellipsis is transverse, and the fissure large, to enable them to see laterally, and even with a little light; and thereby both to gather their food the better in the night, and to avoid dangers on either side. In others, *e. gr.* the cat, the ellipsis is erect, and is also capable of opening very wide, and shutting very close; by means of the latter of which states, that animal can exclude all, but, as it were, a single ray of light, and so avoid all the inconveniences of the bright sun; and by the former, it can take in all the faintest rays, and thus avoid the inconveniences of the night: an incomparable provision for these animals, which are to watch and way-lay their prey both by day and night, to see upwards and downwards, to climb, &c. See *EYE* and *VISION*.

PUPIL, Closure of. A preternatural smallness of the pupil always renders the patient incapable of discerning objects well at night-time, and occasions a diminution of vision. The consequence of a complete closure of the pupil, a case termed *synizesis*, is total blindness. Both these affections only differ from each other in degree, and they originate from the same causes. The most frequent cause is a violent inflammation of the eyes, particularly when such disorder extends to the iris, and arises at a period when the anterior and posterior chambers of the aqueous humour contain none of this fluid. This case principally happens after the extraction of the cataract. Here the inflammation constantly affects the capsule of the crystalline lens, so as to make it opaque, and at the same time adhere behind the pupil to the iris; a circumstance which is well deserving attention. Not unfrequently, however, a closure of the pupil takes place during ophthalmia, notwithstanding both chambers of the eye are full of the aqueous humour. Wounds of the iris sometimes cause this unpleasant occurrence, especially when they continue open, and do not heal. It is observed to be most frequently produced by such wounds as divide the radiated fibres of the iris transversely. These wounds, however, do not invariably remain open: sometimes they close, and then the pupil undergoes no alteration. Even when such wounds do not unite, a closure of the pupil does not always follow. In these instances, the natural pupil has been remarked to become closed, and the preternatural aperture in the iris to be widened, when the eye was exposed to the light; and, on the contrary, immediately the light was diminished, the pupil became dilated, and the other opening was contracted and closed. - Wounds of the iris in the other direction, even when they remain disunited, often cause little or no diminution of the natural motion of the pupil.

It sometimes happens, that a greater or lesser portion of the iris is detached from the circumference of the cornea;

and, in this situation, an oval aperture is produced, through which the rays of light pass into the eye. A complete closure of the pupil is usually the consequence of such detachment of the iris. A blow on the eye, a kick of a horse, or some other external violence, attended with a violent concussion of the eye, is the common cause of this detachment of the iris. Janin has seen it brought on by a prolapsus of the iris through an ulcerated opening in the cornea. The iris was kept in a state of tension, and the patient was suffering constant pain in the eye; but, after a time, this pain suddenly ceased, when it was remarked, that the iris was torn from the upper edge of the cornea at five different points. The patient, who had been deprived of his sight by the closure of the pupil, now recovered it again. Through the aperture, formed by a separation of the iris from the cornea, patients commonly see distant objects tolerably well, notwithstanding the opening is immovable, and not in the centre of the eye; but, in general, they can see only a half of such objects as are near. In cases where the iris is thus detached, the pupil sometimes continues open. Janin once noticed an alternate motion in the pupil and the preternatural opening. Between them the iris was thrown into folds, or wrinkles. Immediately a strong light entered the eye, the wrinkles diminished, the pupil contracted, and assumed a long narrow shape, while the preternatural opening grew larger and wider. In dark places, the latter became smaller, the pupil larger, and the part of the iris situated between them more wrinkled.

Sometimes the pupil becomes closed, in consequence of a spasmodic contraction of the iris. At first, the pupil is merely lessened in diameter; the power of seeing decreases; and at length the eye is very sensible of the light, though not at all inflamed. At last, the pupil is entirely closed. This case presents itself most frequently after operations for the cataract. The pupil occasionally undergoes a gradual diminution after such operations, and in the end is totally obliterated, without any particular cause, inflammation, or pain; and this event may happen several weeks, months, or years, after the time of those operations. It is remarked by surgical writers, that such persons as frequently read for a long while, and attentively look at shining, bright, strongly illuminated objects, run a risk of being attacked with this disorder. The pupil, which contracts itself very much during the inspection of these objects, at length becomes habituated to a state of contraction, and loses all power of expanding itself. Richter observes, that this form of the complaint is termed *synizesis ex consuetudine*.

Infants are sometimes born without pupils. In this case, the situation of these openings is occupied by the membrana pupillaris. By some this affection has been erroneously called *cataracta pupillaris*: as Richter observes, the term *synizesis congenita* is much more applicable to it. A prolapsus of the iris is commonly attended either with a diminution, or a total closure of the pupil. When the iris is reduced in time, the pupil generally expands again; but when the reduction is not effected till after a certain period, this opening remains closed, and this notwithstanding every portion of the iris be now replaced. A prolapsus of the vitreous humour sometimes occasions, and leaves after it, a contracted state of the pupil. Every long continued deficiency of the aqueous, or considerable loss of the vitreous humour, by whatsoever cause produced, is accompanied with risk of a permanent diminution, or even a total closure of the pupil: hence it is often a symptom of *atrophia oculi*.

Sometimes, though the pupil is of proper dimensions, it is obstructed by extraneous matter. This case is termed *synizesis spuria*. The substance producing the obstruction,

is either a portion of coagulated blood, which is the consequence of an extravasation of this fluid in the anterior chamber; thick matter from a suppuration within the eye; or the remains of a diseased lens continuing after the operation of extracting the cataract. A white opaque membrane, like a cyst, is sometimes seen protruding through the pupil into the anterior chamber. The capsular cataract is occasionally so moveable, that, when the head is inclined forwards, it enters the pupil, and partly comes into the anterior chamber; but returns into its former position, as soon as the head is inclined backward again. Mauchart asserts, that he has seen a fungous excrescence growing from the edge of the iris, and filling up the pupil.

When the diminution or closure of the pupil is of long standing, it can never be relieved, except by an operation, whatever may be the nature of the cause from which it originates. When the pupil has been for a long while in a diminished or closed state, it loses entirely the power of expanding again, and continues lessened, or shut, notwithstanding the removal of the cause of the disorder. If the affection be congenital, or the consequence of inflammation, it can never be obviated except by an operation, however short the period of its duration may be. When it arises from irritation of the iris, or from intense observation of shining, bright objects, and has not existed a long time, it may be cured without an operation. Also, in cases where the operation is necessary, the mode of performing it differs according to circumstances.

Patients who become afflicted, in consequence of frequently observing bright, glittering objects, may obtain relief by a timely avoidance of every light that is too strong, wearing green spectacles, viewing objects with an opera glass, and frequently washing the eye with some warm emollient liquor, especially a decoction of mallows, hemlock, and poppy-heads. The peculiar virtue of the extract of belladonna, in making the pupil dilate, might here also be turned to great advantage. It is to be diluted and rubbed over the eye-lids and eye-brow, and allowed to remain applied a certain length of time every day. The same means are likewise proper in cases, where the disorder depends upon irritation. Richter speaks favourably of the good effects of antimonial wine, and the extract of aconitum, as internal medicines, together with warm bathing and blisters. Here the outward application of the extract of belladonna unquestionably merits a careful trial.

There is a preternatural contraction of the pupil, which alternately arises and then ceases again. This case sometimes lasts only a few hours; sometimes several days. During the attack, patients see more weakly than usual, or cannot see but very little, according as the pupil happens to be more or less diminished. In particular instances, the attacks come on at fixed times, and the complaint is then periodical. During the disorder, the pupil seems to be affected with spasm. Occasionally, indeed, spasmodic complaints, says Richter, take place at the same time in other parts. Here the disease is most commonly the consequence of irritation seated in the abdominal viscera, and requires aperient, and especially emetic medicines. When these means prove ineffectual, it is at length necessary to resort to the external and internal use of anodyne tonic remedies, valerian, bark, and small doses of ipecacuanha. The outward application of the extract of belladonna to the eye-brow and eye-lids promises also, in such cases, to be an useful auxiliary means. This sort of closure of the pupil has been observed as a symptom of hysteria.

The eminent Mr. Cheselden first made the proposal of perforating the iris, and also first put such an operation in execution.

execution. He introduced a slender knife, about one line from the margin of the cornea, through the coats of the eye, into the posterior chamber, and pushed it through the iris in the situation of the closed pupil, so as to form in that membrane a small longitudinal incision. It is alleged that this operation of Cheselden's has been repeatedly performed, and for the most part unsuccessfully. According to the observations of Janin and Warner, the incision did not dilate, and became shut up again soon after it had been made. In one example, Janin was prevented from completing the operation with accuracy, in consequence of hemorrhage rendering the aqueous humour turbid. The plan of introducing the knife into the posterior, instead of the anterior chamber, seems also to be disadvantageous; for, in this last mode, the iris can be more easily got at, and nothing is injured except the insensible cornea. On the other hand, in Cheselden's method, all the coats of the eye, the lens and its capsule, and the ciliary processes, are all wounded. Besides, as the point of the knife is concealed behind the iris, one can never be certain that it is precisely opposite the place where the perforation of the iris ought to be made.

It was the opinion of Janin, that when the incision in the iris was made in a parallel direction to the radiated fibres of this membrane, it always very soon closed again; and, on the contrary, that when it was made across these fibres, it not only dilated, but continued permanently open. He, therefore, used to operate as follows: he first divided the lower half of the cornea, as in the operation for the cataract; he then pushed a finely pointed pair of scissors into the iris, about one line from the lower edge of the cornea, and the incision was made in a perpendicular direction on the inside of the pupil, without touching the pupil itself. The cut usually became dilated immediately, and remained open. But care must always be taken to make the wound in the iris on the side of the pupil next the inner canthus, as making it on the opposite side might occasion squinting. See Janin's *Mémoires sur l'Œil*.

Wenzel's plan is more modern. The knife is introduced into the cornea in the manner usually done in the operation for the cataract; but when it has approached within half a line of the place of the closed pupil, its point is to be depressed to the depth of half a line through the iris. Three-quarters of a line from this puncture, towards the inner canthus, the point is to be elevated again; and the incision of the cornea is then to be finished, as in operating for the cataract. In this way, a cut is made in the iris, resembling on a small scale the incision on the cornea; that is to say, it is of a semilunar shape, and forms a small flap; but it is rarely so smooth and even as that in the cornea. The flap is to be cut away with a small pair of scissors, so that a roundish aperture, which is sure to remain open, is produced in the iris. When the flap cannot be got hold of, so as to admit of being removed with scissors, a small piece of the iris is to be cut out.

The method which we have next to take notice of, is that proposed by the eminent Scarpa. He conceives, that the artificial pupil may be most easily made, by detaching a certain extent of the circumference of the iris, next the nose, from the ciliary ligament, by means of a couching needle. Others object, however, that this mode is not only difficult, but that the aperture is hardly ever permanent.

The last way of operating, of which it remains for us to speak, is that recommended by Mr. Gibson. This surgeon begins by making a puncture in the cornea, with a broad cornea knife, within a line of the scleroticæ, to the extent

of about three lines. All pressure is now to be removed from the eye-ball, and the cornea knife gently withdrawn. The consequence of this is, that a portion of the aqueous humour escapes, and the iris falls into contact with the opening in the cornea, and closes it, like a valve. A slight pressure must now be made upon the upper and inner part of the eye-ball, and be gently increased, or varied in direction, till the iris gradually protrudes, so as to present a bag of the size of a large pin's head. This protruded portion must be cut off with a pair of fine curved scissors, and, at the same time, all pressure is to be removed. The iris will then recede within the eye, and the piece that has been removed will leave an artificial pupil more or less circular.

When the centre of the cornea is so opaque, that the rays of light cannot enter the pupil, and the circumference of that membrane is transparent, vision may be materially improved by removing a portion of the iris opposite the undiseased part of the cornea.

There can be no doubt that, with respect to the comparative merit of the preceding modes of operating, Gibson's plan ought in general to be preferred, as being nearer and safer than the others. Consult Sharp's *Treatise of the Operations*; Janin's *Mem. sur l'Œil*; Wenzel on the *Cataract*; Scarpa sulle *Malattie degli Occhi*, capo 16; Richter's *Anfangsgrunde*, &c. band. 3. kap. 9; Gibson's *Pract. Obs. on the Formation of an artificial Pupil*, &c.

PUPIL, *Preternatural Dilatation of.* This affection, which is termed *mydriasis*, is usually a symptom of some other disease, and is hardly ever an original complaint. It occurs in very different degrees. Sometimes the pupil is so considerably expanded, that the iris can just be discerned, like a small fold at the inner circumference of the margin of the cornea. In some cases, the pupil is totally immovable; in others, it retains a certain degree of motion. Not unfrequently, it has lost its round shape, and become of an oblong, or angular figure. In particular cases, the affection is only in one eye; in the majority of instances, it takes place in both. It is often accompanied with total blindness; occasionally, though less commonly, the patient retains the faculty of seeing. In the latter case, the patient has an aversion to the light, or is even quite blind in the day. He is also in constant danger of being totally deprived of vision in a gradual way by the gutta serena. (See *GUTTA SERENA*.) To some patients of this description, all objects appear to be smaller and more distant than they are in reality. The following are the diseases of which mydriasis is commonly a symptom. 1. Amaurosis, or the gutta serena. Of this complaint, however, it is not an inseparable and constant symptom, the pupil sometimes retaining the power of motion, and being quite free from blemish; and in cases where it is dilated and motionless, it now and then recovers its natural size and moveableness, although the amaurosis continues unchanged. 2. The cataract. Here mydriasis happens under two different states; namely, either when the cataract is adherent to the iris; or when the opaque crystalline lens is preternaturally thick and large. In the first case, it usually happens that the pupil is at the same time incapable of motion, and irregular; in the second, it sometimes can move in a certain degree, and the iris is convex and pressed forward toward the cornea. 3. Hydrophthalmia, or dropsey of the eye. Here the dilatation of the pupil arises immediately from the distended state of the eye-ball, and with this the disorder increases or subsides. (See *HYDROPTHALMIA*.) 4. In patients who are troubled with worms; who are in swoons, who are afflicted with hydrocephalus, apoplexy, or any comatose disease, the pupils are in general preternaturally

ternaturally dilated. In all such cases, the only indication is to endeavour to remove the original disease, of which the mydriasis is merely a symptom.

In the case where mydriasis is to be regarded as the only disorder, the complaint seems to depend upon a weakness or paralysis of the fibres which close the pupil. Here it is commonly the consequence of apoplexy, a blow on the eye, or a violent and sudden distention of the pupil, as, for example, sometimes happens in the extraction of a cataract. When the disease is of long standing, there is little hope of cure, whatever may be the cause from which the complaint arises. When it is recent, the pupil will sometimes regain the power of moving and contracting under the use of internal and external stimulating tonic remedies. The chief means of this class are, blisters applied to the eye-brows, ethereal oil rubbed into the skin around the orbit, electricity, emetic medicines in small and full doses, and other similar remedies, which are usually prescribed for the relief of paralytic affections of other parts. When these means prove unavailing, the practitioner must be content with recommending a palliative plan, which will be presently noticed.

As the pupil naturally dilates in the dark, it follows, that when a person is kept a long while away from the light, a *mydriasis ex consuetudine* is produced, the pupil becoming habituated to the expanded state, and losing the power of contraction. In most instances, it gradually recovers its motion after the eye has been for a certain time exposed to the light again. The light, however, must be allowed to get to the eye only by degrees, or else its sudden operation on the eye, in the expanded state of the pupil, would be apt to impair, or even destroy vision altogether. When the pupil does not recover its power of motion, the patient must be satisfied with resorting to palliative means. It has been remarked, that mydriasis is sometimes a congenital defect. All attempts at a radical cure must here be attended with extreme difficulty. When the light cannot be endured without inconvenience, the palliative plan is necessary. A blow on the eye sometimes tears the pupil. The rent mostly remains open, and the patient is in the same state as if affected with mydriasis. Here, as the laceration cannot be repaired, the indication is to prevent, by palliative means, vision from being hurt by the too great strength of the light.

Through a preternaturally dilated pupil the light enters the eye in such quantity, that the patient is blinded. He not only sees things very indistinctly in light places, but he also runs a risk of being gradually entirely deprived of vision, in consequence of the too strong action of the light upon the eye. The prevention of such mischief is the object of the palliative treatment. By it the light which falls upon the eye is to be diminished, so that the patient may be enabled to see not only plainly and without inconvenience in light places, but also without any danger of losing his sight altogether. The usual means recommended for this purpose are, eye-shades, by which the light, coming principally from above, is kept from entering the eye; black veils over the face; green spectacles, which lessen the quantity of rays of light coming from objects which the patient is looking at; spectacles made with black cards, in the centre of which is left an opening of the size of the natural pupil. But the best and most proper means is a pair of tube-spectacles. This is a common pair of spectacles, which, instead of glasses, has adapted to its two rings two conical tubes, the bases of which are to be put towards the eyes, and the narrower parts towards the objects which are looked at. These tubes ought to be made of black leather, and they should be three or four

inches long. Their diameter at the base must be equal that of the circumference of the orbit; but their other ends need not be quite so wide. The edge of their bases is to be cut in such a way, that they will fit closely on the circumference of the orbit. The use of these tubes consists in their keeping off all the rays of light coming laterally, and only admitting those into the eye, which proceed from objects in the axis of vision. Every surgeon will be able, according to circumstances, to multiply and vary the contrivance here described. See Richter's *Anfangsgr. der Wundarzneykunst*, band 3. kap. 10.

PUPILLARIS MEMBRANA, in *Anatomy*, a circular membrane, by which the pupil is closed during the greater part of utero-gestation. See EYE.

PUPILLARITY, or PUPILLAGE, the state of a pupil; in opposition to *purity*.

PUPPET, in *Natural History*. See AURELIA.

PUPPISOS, a name given by some authors to the os frontis. The suture in this bone is also called by many anatomists the *futura puppis*.

PUPPOLA, in *Geography*, a town of Sweden, in the government of Ulea; 45 miles S. of Ulea.

PUPULÆ, a name used by some to express the extremities of the fingers.

PUR, in *Geography*, a river of Russia, which runs into the Tazovskaia gulf. N. lat. 67° 40'. E. long. 78° 34'.

PUR *autre vie*, in our *Lazo-Books*, is used where lands are held for the life of another. See OCCUPANT, and TENANT.

PURA *Eleemosyna*, *pure alms*, denotes a tenure, whereby the churchmen hold lands in Scotland, somewhat on the footing of the primitive clergy.

PURA *Hasta*. See HASTA.

PURALLA BAY, in *Geography*, a bay on the coast of Chili. S. lat. 42° 10'.

PURANA, the common name of a series of poetical romances, considered among the Hindoos as sacred works, the offspring of inspired writers, communicated for the instruction and benefit of mankind. They are ascribed, in their present form, to a celebrated man in the literary history of the Hindoos, whom they call Vyasa. (See VYASA.) He is supposed to have reduced an immense mass of inspired writings into eighteen works, and to have arranged them as they now appear. The following are the titles of these eighteen books, to which the common denomination of Purana is appended when spoken of or referred to. 1. Brahm, or the Great One. 2. Padma, or the lotos. 3. Brahmanda. 4. Agni, or fire. 5. Vishnu. 6. Garuda. 7. The transformations of Brahma. 8. Siva. 9. Linga. 10. Nareda. 11. Skanda. 12. Markandeya, or the immortal man. 13. Bhawishya, or the prediction of futurity. 14. Matsya. 15. Varaha. 16. Kurma. 17. Vamana. 18. Bhagavata. Of these, the first four relate to cosmogony; the next nine to the attributes and powers of the Deity. The sixth is named after the vehicle or bird of Vishnu, called Superna, as well as Garuda. (See SUPERNA.) See LINGA, for the mysterious symbol whence the ninth derives its name. Nareda, whose laws and history are detailed in the tenth, is a mythological son of Brahma. Skanda, the hero of the eleventh, is a name of Kartika; see that article. The fourteenth and three following relate the histories of four of the principal incarnations of Vishnu the preserver, called *Matsyavatara*, *Varahavatara*, *Kurmapatara*, and *Vamanavatara*. Under these articles respectively will be found a brief notice of the outline of their histories. The eighteenth, called Sri Bhagavata, is the life of Krishna, (see KRISHNA,) with

with which the poet Vyasa is popularly imagined to have crowned the whole series; though some reasonably assign them different composers; and the series is differently arranged and named by other authorities. Every Purana treats of five subjects. 1. The creation of the universe. 2. Its progress, and the renovation of the worlds. 3. The genealogy of gods and heroes. 4. Chronology, according to a fabulous system. 5. Heroic history, containing the achievements of demigods and heroes. Since each Purana contains a cosmogony, with mythological and heroic histories, they may, not unaptly, be compared to the Grecian theogonies.

A copy of, we believe, all the eighteen mythological poems, is preserved in the library of the East India house. It is estimated that the whole cannot consist of less than half a million of stanzas. Hitherto no translation of any of them, or of any considerable portion of either, hath been made from the original into any European language. They are, of course, written in the Sanscrit tongue. In some articles of this work a stanza, or a brief outline of some of the Puranic tales, elucidatory of the character or subject under discussion, is occasionally introduced, and may perhaps give some little idea of the style of these extravagant poems. The reader, in this view, may consult the following, in addition to the other articles herein and thence referred to; JAMBAVANTA, KALPA, KARSHAGNI, KRITIKA, LILESWARA, LOTOS, MERU, MUNI, NAKSHATRA, NARAMEDHA, PAVAKA, PAVANA, PIKESWARI, POLLEAR, PRITHU, &c. &c.

As to these extravagant, and not always decent, tales of the Puranas, the probability is that physical or historical facts are thus connected under a veil of allegory, carried through a series of poetical narratives and adventures, related of the personified attributes of the Deity. The facts are either forgotten, or unknown to the vulgar; but the fables remain, and are generally and commonly alluded to in composition and conversation. Taken literally, as the transactions of divine or holy persons, nothing (bating the invention, imagery, and other poetical merits) can be more contemptible than these Puranic romances; but if we desire to extract the grains of ore that the mass may probably contain, we must be content to examine them as they are; and in case of failure, many inquisitive researchers will deem their labour not lost, in the invention and other poetical beauties abounding in these wild compositions.

We shall briefly give an abstract of the contents of two or three of the Puranas, whence a judgment may be formed of the others. The Agni Purana is feigned to have been delivered by Agni, or Pavaka, the god of fire. (See PAVAKA.) It contains a great variety of subjects, and seems to have been intended as an epitome of Hindoo learning. The poem opens with a short account of the several incarnations of Vishnu, an enumeration of which, with a brief outline of their history, will be found in the article VISHNU of this work, and those thence referred to. It dwells, however, chiefly on the incarnations of Krishna and Rama. (See these articles.) Then follow a history of the creation; a tedious dissertation on the worship of the gods, with a description of their images, and directions for constructing and setting them up; a concise description of the earth, particularly of those places which are esteemed holy, with the forms of worship to be observed at them; a treatise of astronomy, or rather astrology; a variety of incantations, charms, and spells, for every occasion. One species of this is named *mantra*, under which article a sufficient account is given of them; computations of the periods called *manvantara*, *kalpa*, &c. (see KALPA); a description of the several religious modes of life called *asrama*, and the duties to be performed in each; rules for

penance (on this head see TAPAS); feasts and fasts to be observed throughout the year; rules for bestowing charity; a dissertation on the great advantages to be derived from the mystic word OM (under which article of this work the reader will probably find sufficient of mysticism), with a hymn to Varishta, of whom something occurs under that article. The next head relates to the office and duties of princes; under which are given rules for knowing the qualities of men and women; for choosing arms and ensigns of royalty; for the choice of precious stones; and a treatise on the art of war. The next head treats of worldly transactions between man and man, as to buying and selling, borrowing and lending, giving and receiving, &c. &c. Then follow certain ordinances, according to the Veda, respecting security from misfortunes, &c. and for the worship of the gods. Genealogies of the two races of solar and lunar kings, called Suryavanra and Chandravanra (see SURYA); of the family of Yadu and of Krishna, with a short history of the twelve years' war, described in the Mahabarat. (See MAHABARAT.) A treatise on the art of healing, as applicable to man and beast, with rules for the management of elephants, horses, and cows; charms and spells for curing various disorders; and the mode of worshipping certain divinities; on the letters of the Sanscrit alphabet; on the ornaments of speech, as applicable to oratory, poetry, and the drama; on the mystic signification of the single letters of the Sanscrit alphabet; a grammar and short vocabulary of that language. The whole of this desultory work is divided into 353 short chapters.

The Siva Purana is sometimes called also, after one of the forms of his consort, the Kalika Purana. (See KALI.) It is a mythological history of that goddess, including her adventures under various names and characters. Many of those names and characters are enumerated under the article PARVATI, her more common name; and Mr. Moor has given an extract under *Naramedha*, which word means a man-sacrifice, the rites and ceremonies of that horrid offering being minutely laid down in this Purana. It is a curious and entertaining work, including as episodes several beautiful allegories, particularly one founded on the motions of the moon. See Moor's Hindu Pantheon.

The Vayu Purana, as one of these poetical romances is variously called, but *which* we have not the means at this moment of ascertaining, is attributed to the regent of wind Vayu, otherwise and more commonly called Pavana (see PAVANA); where the reason is furnished why the Purana is not called after that name. It contains, among a variety of other curious subjects, a circumstantial detail of the creation of all things, celestial and terrestrial, with the genealogy of the first inhabitants; chronological computations as to the grand periods *manvantara*, *kalpa*, &c. before spoken of; a description of the earth, as divided into islands, continents, &c. and its dimensions, and also of other planets and fixed stars, their distance, circumference of orbits, &c. &c. Under the article PAVANA, an extract is given from the Matsya Purana, directing how images or pictures are to be made of the god of wind. Most of the Puranas contain directions of that sort.

A brief notice of one other of these inspired works will suffice. The Nareda Purana is believed to have been delivered by the inspired Nareda, a mythological son of Brahma. Under the article *Nareda*, (see Hindu Pantheon) an account is given of him, with his genealogy, and the derivation of his name, from the Varaha Purana. Like the others, this poem opens with describing "how heaven and earth rose out of chaos;" but it treats principally of the unity of God, and as it sectariaily is written with the Vaishnava bias (see VAISHNAVA),

NAVA), it describes Vishnu as the Deity. On this point, see *SECTS of Hindoos*. It argues that all other gods are but emblems of the works of Maha Vishnu, and the female deities, or faktis, emblems or personifications of his powers. Other Hindoo sects say the same of the deity of their exclusive worship, as noticed under KRISHNA, RAMA, SIVA, &c. It states that the worship of the Trimurti, or either of the triad (see TRIMURTI), whether the creator, preserver, or regenerator, is in effect worshipping of Vishnu. This Purana concludes with rules for the several tribes in their spiritual and temporal conduct through life.

These voluminous and certainly curious poems, are held in the general estimation of the Hindoos, as second only to the Veda, their immediate scripture. (See VEDA.) In each of the Vedas are certain passages interspersed, relating chiefly to cosmogony, which are called Purana, but are wholly different from the eighteen mythological poems, the subject more especially of this article.

With respect to the age of the Puranas, orientalists differ widely. Sir W. Jones satisfied himself that they have been written about 2500 years. He does not state precisely the mode of reasoning, by which he arrived at this conclusion; he gives, however, the outline of the process, and asks the public to give him credit for a few very curious facts, which, although, he says, capable of strict proof, could then be only asserted. We are not aware that the proofs were ever submitted to the public; and whatever they were, they have not wrought conviction on the minds of all. Mr. Colebrooke, however, (As. Ref. vol. vii.) leaves us to infer that he thought them very little inferior in point of antiquity to the age assigned them by his illustrious predecessor in the chair of the Asiatic Society. Mr. Wilford expressly says, that "the Puranas are certainly a modern compilation from valuable materials, that I am afraid no longer exist: an astronomical observation of the heliacal rising of Canopus, mentioned in two of the Puranas, puts this beyond doubt." (As. Ref. vol. v.) Mr. Bentley, after giving various reasons and calculations for the foundation of his opinion, says, "It must be evident that none of the modern romances, commonly called the Puranas, at least in the form in which they now stand, are older than 684 (now 1813, about 695) years, but that some of them are the compilations of still later times." (Ib. vol. viii.) As far, indeed, as the eighteenth Purana, called Sri Bhagavat, is concerned, Mr. Colebrooke countenances Mr. Bentley's opinion. "I am inclined," he says, "to adopt an opinion supported by many learned Hindoos, who consider the celebrated Sri Bhagavata as the work of a grammarian, supposed to have lived about 600 years ago." Ib. (See SRI BHAGAVAT.) Be this as it may, the orthodox Hindoos have implicit faith in, and great veneration for, those celebrated poems, or "sacred histories," as they call them; and it is authoritatively asserted, that "the Veda, the revealed system of medicine, the Puranas, and the code of Menu, are four works of supreme authority, which ought never to be shaken by arguments merely human." (See MENU.) There are, however, many individuals of all the four tribes of Hindoos, fewest certainly in that of Brahmana, who correspond with the Levites of Israel, who deny the divine origin of the Puranas, looking upon them in nearly the same light as a rational critic of Europe may do.

PURANGURAH, in *Geography*, a town of Bengal; 20 miles S.E. of Islamabad.

PURARI, a name of the Hindoo deity *Siva*; which see.

PURARYA, in *Geography*, a town of Hindoostan, in Oude; 32 miles N. Kairabad.

PURBACH, GEORGE, in *Biography*, an eminent mathematician and astronomer in the 15th century, was born at Purbach, a town on the confines of Austria and Bavaria, in 1423. He was educated at Vienna, where he manifested great talents, and took his degree of M. A. with great applause. He directed his attention principally to mathematics, and advanced in that science with almost incredible rapidity. For farther improvement, he visited the most celebrated universities of Germany, France, and Italy. He found a particular friend and patron in cardinal Cusa, and he formed an intimacy with John Blanchini of Bologna, who admiring Purbach's extensive knowledge, and his ready method of communicating instruction, wished to prevail upon him to deliver lectures on astronomy at Ferrara; but Purbach preferred returning to Vienna, where he obtained the mathematical professorship in that university. About this time he received offers from Ladislaus, king of Hungary, to become his astronomer, accompanied with promises of liberal rewards and distinguished honours, which he declined.

The fame of Purbach, as a mathematical professor, was soon widely diffused, and brought numerous students to attend his lectures at Vienna. Among others was the celebrated Regiomontanus, who secured the esteem of his master, and was chosen the assistant and companion in his labours. From this time they maintained an union of studies, in their endeavours to improve the different branches of mathematical science, and more particularly astronomy. This science they would, no doubt, have materially improved by their joint labours, had Purbach's life been prolonged. His first essay was to amend the Latin translation of Ptolemy's *Almagest*. After this he wrote "An Introduction to Arithmetic," and proceeded to draw up another "On Gnomonics," or dialling, with tables suited to the difference of climates and latitudes. This was followed by a small tract "Concerning the Altitudes of the Sun," with a table, and "Astronomic Canons." After this he made solid spheres, or celestial globes, and not only explained their construction and uses, but added to them a new table of fixed stars, with the longitude by which every star had increased, from the time of Ptolemy to the middle of the fifth century. He also invented various other instruments, among which was a "gnomon," or geometrical square, with canons, and a table for the use of it, which he sent to the archbishop Strigonia, who was himself a man of great erudition, and entertained a high opinion of Purbach. Our author made considerable improvements in trigonometry; prepared tables of the fixed stars, and undertook to reform those of the planets, and constructed some entirely new ones. When these tables were finished, he drew up a kind of perpetual almanack, chiefly for the moon, answering to the periods of Meton and Calippus: also an almanack for the planets, or, as it was afterwards called, an Ephemeris for many years. He finished his "*Theoria Novæ Planetarum*," (see MULLER,) which was made a textbook in all the schools, and was commented upon by some of the most eminent mathematicians. Purbach died in the 38th year of his age, in 1461.

PURBECK, *Isle of*, in *Geography*, a district in the Blandford division of the county of Dorset, England, is bounded on the west by Luckford lake; on the south by the British channel; and on the other side by the river Frome, and the bay of Pool. It is improperly called an island, being in fact only a peninsula, as it may be entered from East Lulworth by an isthmus, between the head of Luckford lake and the sea. This district extends twelve miles in length, and varies from seven to ten in breadth.

It includes two hundreds, called Hazler and Rowbarrow, the former comprehending the eastern division of the isle, and the latter the western. These are subdivided into nine parishes, and contain one town, Corfe-castle, and several large villages and hamlets. The soil is every where calcareous; but the surface is much diversified by hill and dale. The quarries, shores, and cliffs, on the south side of the isle in particular, afford an inexhaustible fund of natural curiosities. Near Kington, Worth, Langton, and Swanwich, are extensive quarries of freestone; and in many parts is a stone that rises thin, and is used for tiling; also a hard paving stone, much of which was used in rebuilding London after the fire, and in paving the streets and courts. At Swanwich is a white stone full of shells, which takes a high polish, and looks like alabaster; and near Dunshay is dug up marble of various colours, but chiefly a grey kind, formed by a congeries of shells, and anciently much used for grave stones and monuments. It was likewise very generally employed for small columns in the churches which were erected during the 13th century. The cornua ammonis are frequently discovered here, some of them two or three feet in diameter.

In ancient times the whole of this isle was a forest, and was well stocked with red and fallow deer, and stags, especially in the west parts; but these were almost entirely destroyed in the civil wars. James I. was the last of our kings who hunted here. The whole isle was till lately governed by a lord-lieutenant, who was admiral of the isle, and had power to raise and muster a militia; but this office ceased when the regular militia act was passed. Formerly there were many gentlemen's seats dispersed all over the isle; which were probably built for the reception and accommodation of the nobility and gentry who attended the royal hunts, as most of the owners of estates in this part of the country had their principal seats elsewhere, and only came hither in the hunting seasons. These are now almost, without exception, converted into farm-houses. For an account of the only town in Purbeck, see CORFE-CASTLE. Hutchins's History and Antiquities of the County of Dorset, 2d edit. by Gough. Beauties of England and Wales, vol. iv. by John Britton, and E. W. Brayley.

PURBECK Stone, the *saxum arenarium cinereum Purbecense* of Da Costa, and *psadurium friabile albido fuscum* of Hill, is an alkaline sand-stone, which is harsh and rough, of a disagreeable ashen colour, very heavy, and moderately hard, of a texture not very compact, but somewhat porous, and is composed of an angular grit, cemented together by an earthy spar: it cuts freely, and with a tolerable even or smooth surface, but will not take a polish. It will not strike fire with a steel, and burns to a white colour. The quarries of this stone are in the island of Purbeck, in Dorsetshire, whence it is brought to London in great quantities, and used in building, and for pavements. Its specific gravity is 2.68. There is also another kind of Purbeck stone, the *saxum fusco-albidum* of Da Costa, and the *sympexium durissimum, splendidum albido-fuscum* of Hill, which is alkaline, of a dull, disagreeable, pale, brownish, white colour, and is not capable of a polish, though it cuts to a very smooth surface: it is of a fine, close, compact texture, not quite destitute of brightness, but full of sparks of pure spar, and intimately mixed with vast quantities of small pectunculi, which are often saturated and filled with the same substance; it is very heavy and hard, and water does not pervade its texture; it does not strike fire with steel, and when burnt, acquires a clear ashen colour. This stone is brought from Purbeck, and used in building, pavements, &c. Hill informs us, that it is likewise found in many other parts of the kingdom, and

that there are large strata of it in Yorkshire. Da Costa's Fossils, p. 128—152.

PURBUTTY, in *Geography*, a river of Hindoostan, which runs into the Chumbul; seven miles W. of Suifopour, in the country of Agimere.

PURCARI, a town of European Turkey, in Bessarabia, on the Dniester; 4 miles S.E. of Bender.

PURCELAIN. See PORCELAIN.

PURCELL, HENRY, in *Biography*, an English musician of more extensive genius than perhaps our country can boast at any other period of time, was born in 1658. His father, Henry, and uncle, Thomas Purcell, were both musicians, and gentlemen of the chapel royal, at the restoration of king Charles II. There is a three-part song in Playford's "Musical Companion," by Henry Purcell, which, being printed in 1667, when our great musician was but nine years old, must have been the production of his father. There is likewise a chant in the first volume of Boyce's Collection, p. 289, N° II, called the "burial chant," by Thomas Purcell, his uncle, who continued in the service of the chapel till the time of his death, in 1682. Though these compositions promise no great hereditary genius, they are mentioned here, as mankind is naturally curious concerning every thing that is connected with eminent persons.

From whom Henry received his first instructions in music, cannot be very clearly ascertained. But his father dying in 1664, when he was no more than six years old, it is probable he was qualified for a chorister by Capt. Cook, who was master of the children from the restoration till the time of his death, in 1672. For, as Purcell was appointed organist of Westminster Abbey at eighteen years of age, he must have learned the elements of his art before his fourteenth year, at which time Pelham Humphrey, brought up in the royal chapel under Capt. Cook, was appointed his successor, as master of the boys. Purcell certainly continued to sing in the king's chapel, and to receive lessons from Humphrey till his voice broke, an accident which usually happens to youth at sixteen or seventeen years of age: after this, perhaps, he had a few lessons in composition from Dr. Blow, which were sufficient to cancel all the instructions he had received from other masters, and to occasion the boast inscribed on the tomb-stone of Blow, that he had been

"Master to the famous Mr. Henry Purcell."

But there is nothing more common than this petit larceny among musicians: if the first master has drudged eight or ten years with a pupil of genius, and it is thought necessary, in compliance with fashion or caprice, that he should receive a few lessons from a second, he instantly arrogates to himself the whole honour, both of the talents and cultivation of his new scholar, and the first and chief instructor is left to sing, *sic vos non vobis*.

Purcell is said to have profited so much from his first lessons and close application, as to have composed, during the time of his being a singing boy in the chapel, many of his anthems, which have been constantly sung in our cathedrals ever since. Eighteen was a very early age for his being appointed organist; that is, maestro di capella of Westminster Abbey, one of the first cathedrals in the kingdom for choral compositions and performance. It was not likely he would stop here: the world is, perhaps, more partial to promising youth than accomplished age; and at twenty-four, in 1682, he was advanced to one of the three places of organist of the chapel royal, on the death of Edward Low, the successor of Dr. Christopher Gibbons, in the same station.

After this, he produced so many admirable compositions for the church and chapel of which he was organist, and where he was sure of having them better performed than elsewhere, that his fame was soon extended to the remotest parts of the kingdom.

From this time, his anthems were eagerly procured, and heard with pious rapture wherever they could be performed; nor was he suffered long to devote himself totally to the service of the church. He was, very early in life, solicited to compose for the stage, and chamber, in both which undertakings he was so superior to all his predecessors, that his compositions seemed to speak a new language; yet, however different from that to which the public had been long accustomed, it was universally understood. His songs seem to contain whatever the ear could then wish, or heart could feel.

We have been assured by a very good judge of music, who was nineteen years of age when Purcell died, and remembered not only his person very well, but the effect which his songs had on himself and the public at that time, when many of them were first heard; and used to say, that "no other vocal music was listened to with pleasure, for near thirty years after Purcell's death; when they gave way only to the favourite opera songs of Handel."

The unlimited powers of this musician's genius embraced every species of composition that was then known, with equal felicity. In writing for the church, whether he adhered to the elaborate and learned style of his great predecessors Tallis, Bird, and Gibbons, in which no instrument is employed but the organ, and the several parts are constantly moving in fugue, imitation, or plain counterpoint; or, giving way to feeling and imagination, adopted the new and more expressive style of which he was himself one of the principal inventors, accompanying the voice-parts with instruments, to enrich the harmony, and enforce the melody and meaning of the words, he manifested equal abilities and resources. In compositions for the theatre, though the colouring and effects of an orchestra were then but little known, yet as he employed them more than his predecessors, and gave to the voice a melody more interesting and impassioned than, during the seventeenth century, had been heard in this country, or perhaps in Italy itself, he soon became the darling and delight of the nation. And in the several species of chamber music which he attempted, whether sonatas for instruments, or odes, cantatas, songs, ballads, and catches, for the voice, he so far surpassed whatever our country had produced or imported before, that all other musical productions seem to have been instantly consigned to contempt or oblivion.

As many of his numerous compositions for the church, particularly those printed in the second and third volumes of Dr. Boyce's Collection, are still retained in the king's chapel, and in our cathedrals, we shall here acquaint the musical reader in what manner we have been affected by some of these productions. in a late attentive perusal of them.

It appears by Dr. Bayly's "Collection of the Words of Anthems used in his Majesty's Chapel Royal," that ten of Purcell's are still performed there; and in the late Rev. Mr. Mason's "Copious Collection of the Words of such Anthems as are used in the Cathedral of York," that nearly twenty of his choral compositions are still sung in that choir.

Purcell's four-part anthem, "O God, thou art my God;" (Boyce's Collection, vol. ii. p. 148.) must certainly have been one of his juvenile productions, before he had sufficiently refined his ear, or exercised his judgment; as there are many

crude harmonies, and false accents in it, which in riper years he would not have tolerated.

Of his six-part anthem, "O God thou hast cast us out," the first movement, in which there are many bold harmonies, is extremely elaborate, yet spirited and pleasing. The verse, "O be thou our help," is not only full of new and fine effects, but touching. By those who object not to the confusion in the words which arises from fugue and imitation, while the several parts are singing different portions of the same sentence, at the same time, the words will appear perfectly well accented and expressed.

The first movement of his full anthem in eight parts, "O Lord God of hosts," is a noble composition, *alla Palestrina*, in which all the laws of fugue upon two, and sometimes more, subjects, are preserved inviolable; the harmony, though bold, is, in general, chaste, and the effect of the whole spirited and majestic. The second movement is extremely pathetic and expressive; but, both in that and the last movement, he seems trying experiments in harmony; and, in hazarding new combinations, he seems now and then to give the ear more pain than pleasure.

The two-part anthem, "Thy way, O God, is holy," continues to be excellent music still, in the slow movements; the quick, however, seems somewhat antiquated, and the melody to these words, "the air thundered," &c. seem too light and dramatic for the church at any period.

The three-part anthem, "Be merciful unto me, O God," is admirable throughout. Indeed, to our conceptions, there seems no better music existing, of the kind, than the opening of this anthem, in which the verse, "I will praise God," and the last movement, in C natural, are in melody, harmony, and modulation, truly *divine music*.

The complete service of Purcell, in B flat, printed by Boyce, is a most agreeable and excellent piece of counterpoint, of which the modulation frequently stimulates attention by unexpected transitions, yet of so sober a kind as never to give the ear the least uneasiness, till we come to the bottom of p. 110, and then the same crudities of the sharp 3d and flat 6th, and flat 3d, 4th, and 5th, which we have already censured in the works of Dr. Blow, occur; which we hope, in spite of our partiality for Purcell, the organists of our cathedrals scruple not to change for better harmony.

These two or three combinations, like some words and phrases which Shakspeare tried unsuccessfully to render current, have been rejected by posterity; and it is in vain to attempt at forcing them upon the public by the mere weight of authority. The ear will patiently bear very rough usage from an artist who in general makes it such ample amends; however, there are limits, beyond which it is unsafe to exercise cruelty of all kinds; and the auricular sense will be deadened, disgusted, or rendered indifferent to music's powers, by too harsh treatment.

The "Benedictus," as well as "Te Deum," and all the rest of the service, must be extremely pleasing, in all other respects, to every ear sensible to harmony. The words are, in general, accented with great accuracy (except the contracting *highest* into a monosyllable, to which only one note is given); and the few points of imitation are fragments of agreeable melody. In p. 121 of Boyce, the A b and A a, at the word *befeech*, in the Kyrie, are peculiarly beautiful, as are the 7th with the 9th at "before all worlds," in the creed, and the close at "by whom all things were made." The point at "throughout all generations," in the Magnificat, is what the Italians call *ben tirato*, well-worked. In the last line, however, of page 132, so many exceptionable combinations

nations occur, that we cannot pass them over without a stigma. Yet, upon the whole, the abilities of Purcell, as a profound contrapuntist, appear perhaps more in the course of this service than elsewhere; as he has manifested deep study and meditation in a species of writing to which it was not likely that his creative and impetuous genius would submit, having had the patience, as well as abilities, to enrich it with no less than four different canons, of the most difficult construction, as of two, three, and four in one, by inversion.

The superior genius of Purcell can be fairly estimated only by those who make themselves acquainted with the state of music previous to the time in which he flourished; compared with which, his productions for the church, if not more learned, will be found infinitely more varied and expressive; and his secular compositions appear to have descended from another more happy region, with which neither his predecessors nor contemporaries had any communication.

Besides the whole service, with three full, and six verse anthems, in Dr. Boyce's Collection, there are nine verse and full anthems, wholly different, still sung in the cathedral at York. And in Dr. Tudway's Collection, British Museum, there are, besides a whole service in B flat, different from that in Boyce, eight full and verse anthems, different from all the rest, four of which were composed for the chapel royal of Charles II., and are accompanied with instruments. And still, exclusive of these and the hymns printed in the two books of "Harmonia Sacra," in a manuscript bequeathed to Christ-church college, Oxon. by Dr. Aldrich, there are two motets, and a "Gloria Patri" for four and five voices, in Latin, with seven psalms and hymns for three and four voices, by our fertile and diligent composer, that have all their peculiar merit, but of which some may, without hyperbole, be said to reach the true sublime of sacred music.

To enter into a minute examination of these, and his admirable *Te Deum* and *Jubilate*, composed for St. Cecilia's day, 1694, would extend this article to too great a length; though they merit much praise as well as critical remark; for which, on the *Te Deum* we refer our readers to the ample account of him and his works, in Burney's *History of Music*, vol. iii.

Purcell's theatrical compositions, if we recollect the number and excellencies of his productions for the church, and the shortness of his life, will surprise by their multiplicity as well as singular merit. Of those dramas which are called operas, and of which music and decorations were the principal allurements held out to the public, a detailed account is given in speaking of the origin and progress of the musical drama in England, previous to the use of the Italian language, music, and performers on our lyric stage. (See *MASQUES*, and *MATTHEW LOCK*.) And of Purcell's detached and incidental songs, dialogues, and scenes that were performed at our national theatre, or playhouse, the principal will be mentioned in speaking of his "*Orpheus Britannicus*," or posthumous collection of his miscellaneous compositions. But before we enter on an examination of this work, it seems necessary to acquaint the reader, that the chief part of his instrumental music for the playhouse is included in a publication that appeared two years after his decease, under the title of "*A Collection of Ayres composed for the Theatre, and on other Occasions*, by the late Mr. Henry Purcell. London, printed for Frances Purcell, Executrix of the Author, 1697." These airs are in four parts, for two violins, tenor and base, and were played as overtures and act-tunes in our own memory, till they were

superfeded by Handel's hautbois concertos, and those, by his overtures, while Boyce's sonatas, and Arne's compositions, served as act-tunes. In process of time these were supplanted by Martini's concertos and sonatas, which were thrown aside for the symphonies of Van Maldere, and sonatas of the elder Stamitz. About this time, the trios of Campioni, Zanetti, and Abel, came into play, and then the symphonies of Stamitz, Canabich, Holtzbauer, and other Germans, with those of Bach, Abel, and Giardini; which, having done their duty many years very pleasantly, "slept with their fathers;" and at present give way to Van-hall, Boccherini, Haydn, and Pleyel. "*Sic transit gloria musicorum!*"

Purcell seems to have composed introductory and act-tunes to most of the plays that were brought on the stage during his time. The publication of these, in four parts, contains his music to the following dramas:

"*Abelazor*," 1677. The music of this consists of an overture, and eight airs or tunes.

"*The Virtuous Wife*," 1680. Overture and seven airs.

"*Indian Queen*." The first movement of this overture is equal to any of Handel's. There are likewise two or three trumpet-tunes, well calculated for the instrument, and a rondeau at the end, which would now seem new, if played in a concert by a good band.

"*Dioclesian, or the Prophetess*," 1690. The instrumental music of this English opera given here, consists of an overture of two movements, the first excellent in the style of Lulli, and afterwards of Handel, with better fugues; *preludio*, accompaniment to a song, trumpet-tune, air, horn-pipe, country-dance, and *canaries*.

"*King Arthur*," 1691. Overture and twelve tunes.

"*Amphitryon*," 1691. Overture and eight tunes.

"*Gordian Knot untied*," 1691. Overture and seven tunes.

"*Distressed Innocence, or the Princess of Persia*," 1691. Overture and seven tunes, all proofs of the author's original genius.

"*The Fairy Queen*," 1692. Two overtures and sixteen tunes of different kinds. No 12, an air, 4 in 2, is a very curious canon on two subjects: the first treble and base performing one, and the second and tenor the other. There is as much accent and spirit in this composition, as if it were in free counterpoint.

"*The Old Bachelor*," 1693. Overture and eight tunes.

"*The Married Beau*," 1694. Overture and eight tunes, among which is a very agreeable air for the trumpet, a march, and a hornpipe, that are characteristic. This last is very much in the style of a Spanish fandango.

"*The Double Dealer*," 1694. Overture and ten tunes. No 6 and 9, pretty and curious.

"*Bonduca*," 1695. Overture and eight tunes, including "Britons strike home," and "To arms," in four parts.

These are the contents of this posthumous publication; but besides the music for these dramas, he composed overtures, act-tunes, and songs, for "*Timon of Athens*," 1678; for "*Theodosius, or the Force of Love*," 1680; for Dryden's "*Tempest*," 1620; and for "*Don Quixote*," 1694.

But few of Purcell's single songs seem to have been printed during his life. He published the music to a masque sung in the tragedy of "*Oedipus*," when it was revived in 1692. And "a musical entertainment, performed Nov. 22, 1683, on St. Cecilia's day, printed in score by John Playford, with a dedication to the gentlemen of the musical society, and particularly the stewards, written by Henry Purcell, composer of the music."

There are several of his songs in Playford's Collection, called "The Theatre of Music, 1687, fourth and last Book;" and though these are not in his best manner, they are more original and interesting than the rest. Among these, p. 50, "A new song to a Scotch tune," by our author, seems to us more pleasing and less stolen, than any spurious Scotch tune, or imitation of the national melody of the northern inhabitants of this island, that has been since produced.

Page 62 of the same Collection, there is an admirable piece of recitative, in a truly grand style: "Amidst the shades," &c. But the collection of his secular vocal music, which did him the greatest honour, and long rendered his name dear to the British nation, was published by his widow two years after his decease, by the title of "Orpheus Britannicus." Here were treasured up the songs from which the natives of this island received their first great delight and impression from the vocal music of a single voice. Before that period we had cultivated madrigals, and songs in parts, with diligence and success; but in all single songs, till those of Purcell appeared, the chief effects were produced from the words, not the melody. For the airs, till that time, were as unformed and mis-shapen, as if they had been made of notes scattered about by chance, instead of being cast in an elegant mould. Exclusive admirers of modern symmetry and elegance, may call Purcell's taste barbarous; yet in spite of superior cultivation and refinement, in spite of all the vicissitudes of fashion, through all his rudeness and barbarism, original genius, feeling, and passion, are, and ever will be, discoverable in his works, by candid and competent judges of the art.

To this admirable collection are prefixed seven copies of verses to his memory, at the head of which is an ode, written on his death, by Dryden, which was set by Dr. Blow, and performed at the concert in York Buildings.

There are few songs in the "Orpheus Britannicus" but what contain some characteristic marks of the author's great and original genius. The melody, however, will at first seem to many at present uncouth and antiquated; but by a little allowance and examination, any one possessed of a great love for music, and a knowledge of our language, will feel, at certain places of almost every song, his superior felicity and passion in expressing the poet's sentiments which he had to translate into melody.

The favourite songs with Purcell's admirers in our youth, were the following; and upon a late attentive perusal of the book, they seem to have merited particular distinction. "Celia has a thousand charms:" the first movement of this, like many of Purcell's songs, seems only *recitative* graced, or embellished with the fashionable *volute*, or *flourishes* of the times, which are now as antiquated as the curls of his own perruque, or the furbelows and slounces of queen Elizabeth. The second movement, however, of this song, is plaintive and graceful; and at "I should my wretched, wretched, fate deplore," is still new and pathetic.

"You twice ten hundred deities," opens with what seems to us the best piece of recitative in our language. The words are admirably expressed throughout this song, by modulation as well as melody. And there is a propriety in the changes of movement, which does honour to Purcell's judgment, as much as the whole composition to his genius. The change of style and sluggish motion given to the notes at these words, "from thy sleeping mansion rise," is a model of musical imitation and expression. The modulation is still so excellent, that the best modern masters are obliged to adopt it on almost all great occasions.

Of the music to "King Arthur" we shall say but little,

as it has been lately revived, well performed, and printed. If ever it could be said with truth of a composer, that he has *devancé son siècle*, outstript his age, Purcell is entitled to that praise; as there are movements in many of his works which a century has not injured, particularly the duet in King Arthur, "Two daughters of this aged dream," and "Fairest isles all isles excelling," which contain not a single passage that the best composers of the present times, if it presented itself to their imagination, would reject. The dialogue in the "Prophetess," "Tell me why, my charming fair," is the most pleasing and ingenious of all the compositions of the kind which the rage of fashion produced during fifty years. The first part of "O lead me to some peaceful gloom," is truly elegant and pathetic.

"From rose bow'r's," is said to have been "set in his last sickness," at which time he seems to have realized the poetical fable of the swan, and to have sung more sweetly as he approached nearer his dissolution; for it seems to us as if no one of his productions was so elevated, so pleasing, so expressive, and throughout so perfect, as this. The variety of movement, the artful, yet touching modulation, and, above all, the exquisite expression of the words, render it one of the most affecting compositions extant to every *Englishman* who regards music not merely as an agreeable arrangement and combination of sounds, but as the vehicle of sentiment, and voice of passion.

There is more elegant melody, more elaborate harmony, more ingenious contrivance, in the motion and contexture of the several parts than in the works of many great composers; but to the natives of England, who know the full power of our language, and feel the force, spirit, and shades of meaning, which every word bears according to its place in a sentence, and the situation of the speaker, or singer, we must again repeat it, this composition will have charms and effects, which, perhaps, Purcell's music only can produce.

"When Mira sings," is a duet that will ever be captivating, as long as the words remain intelligible; of which he has augmented the force, particularly at the end, by notes the most select and expressive that the musical scale can furnish.

"Loft is my quiet," another duet, which still lives. And "Celebrate this festival," a birth-day song for queen Mary, which is graceful and pleasing through all its old-fashioned thoughts and embellishments. "I'll sail upon the dog-star," has all the fire of Handel's prime.

"Mad Befs" is a song, or rather a cantata so celebrated, that it needs no panegyric, or renewal of public attention, as every captivating English singer in our memory has revived its favour. The first Mrs. Sheridan and Mrs. Bates never gave more exquisite delight by their admirable performance, than when they regaled their friends with this song. Beard, forty years ago, used to acquire great applause by singing Purcell's "Rofy Bowers;" and Frasi, by her performance of "Mad Befs," in the concerts at Hickford's rooms, the Castle, and Swan concerts, where Stanley was justly admired for his ingenious and masterly manner of accompanying them. "'Tis Nature's Voice," is an enigmatical song, seemingly on music, in which Purcell has crowded all the fashionable passages of taste and vocal difficulties of the times. Indeed, he seems to have anticipated many fantastical feats of execution and articulation in which great performers have since rioted; and this is the more wonderful, as the Italian opera was not established, or even attempted here, during the life of Purcell; whose decease preceded the arrival of Valentini and Nicolini, the first great fingers imported from Italy, at least ten years.

"Blow,

"Blow, Boreas, blow," was in great favour, during our youth, among the early admirers of Purcell; but this seems now more superannuated than any of his popular songs.

"Let Cæsar and Urania live," was a duet in a birth-day ode, during the reign of king William and queen Mary, which continued so long in favour, not only while those sovereigns jointly wielded the sceptre, but even when George II. had lost his royal comfort, and there ceased to be a queen, or Urania, for whom to offer up prayers, that Dr. Green, and afterwards Dr. Boyce, used frequently to introduce it into their own and the laureate's new odes. This duet, like many other productions of Purcell, was built on a *ground-bass* of only two bars, which are invariably repeated to different passages of the voice-parts that are in harmony with it, throughout the movement. The latter part of this duet is extremely beautiful, and does not seem at all to have suffered from the voluntary restraint under which the composer laboured.

The composing songs on a ground-bass, was an exercise of ingenuity, in which Purcell seems to have much delighted; but though it was as much a fashion in his time, as the composing masses on the subjects of old tunes in the days of Jusquin, and variations upon those tunes in the days of Bird and Dr. Bull, in which they all manifested superior abilities, yet the practice was Gothic, and an unworthy employment for men possessed of such genius and original resources. The Italians started this, as well as most other musical fashions; for it appears by the works of Tranquino Merula, published 1635, that writing upon a ground-bass was a favourite occupation with that capricious composer, as well as our ingenious countryman.

Judges of musical design, modulation, and expression, will meet with many places to admire in songs that have never been popular, yet have local beauties, and mark the superior powers of the composer; particularly in the "Sighs for the death of king Charles II." In the "Dialogue in tyrannic Love," p. 158, there is a passage upon which the late Mr. Baeh constructed a favourite movement in one of his *Quartetti concertanti*.

"I attempt from love's sickness," is an elegant little ballad, which, though it has been many years dead, would soon be recalled into existence and fashion, by the voice of some favourite singer, who should think it worth animation.

"Let the dreadful engines:" this is the last song in the first volume of the "Orpheus Britannicus," of which, though both the words and music of the first movement are wild and bombast, yet the second and last discover a genius for the graceful comic, as well as the tender and sublime style of composition; and there are several passages in this cantata sufficiently gay and new for a modern burletta.

In 1702, a second, and more correct, edition, of the first volume of this work was published, with more than thirty songs that were not in the first impression; but, in order to make room for which, some of the former were excluded.

The same year was likewise published a second volume of "Orpheus Britannicus," by Henry Playford, which he dedicated to the earl of Halifax. The song of this second volume, p. 4, beginning, "Ah! cruel nymph!" has great ingenuity in the first movement, and grace in the second. And the next air, "Crown the altar," seems the most pleasing of any that he has composed on a ground-bass. "May the god of wit inspire," for three voices, is natural and pleasing, and the echoes in the second part are very ingeniously contrived.

"Thus the gloomy world," accompanied with the trumpet, and violin alternately, is masterly, and well designed to display the truest and most brilliant tones of the trumpet,

though but little is given to the violin, which so much better deserves employment, than an instrument of such false intonation as the trumpet.

Those that can relish good music of every age and country, and have no exclusive partiality to individuals of either, will find amusement in the performance or perusal of Purcell's "Four Seasons," in the "Fairy Queen," which comprehend merit of various kinds.

"To arms, to arms," is an admirable military song, accompanied by a trumpet, which is so confined an instrument, that nearly the same passages must be used in all ages, so that time has robbed this song of but little of its novelty. Indeed, the divisions of this air have been revived of late years, and are now as fashionable, in frivolous and unmeaning melody, as ever.

There are many excellent songs in this volume; however, these and their peculiar beauties we must pass over, or our commentary will encroach too much on the limits of our biographical articles, as well as on the time and patience of those readers to whom the name and productions of our British Orpheus are alike unknown or indifferent. Yet we must observe, that there is a composition in Purcell's "Bonduca," in which he has anticipated a species of dramatic music, which has been thought of late invention; the words are "Hear ye gods of Britain!" which he has set in an *accompanied recitative, à tempo, or aria parlante*. The beginning, however, with the *bass à pedale*, has the true characteristic of recitative. Afterwards, when the *bass* is put in motion, the whole has the properties of an air, ingeniously and spiritedly accompanied by two violins and a *bass*. Besides the true dramatic cast of this composition, there are new harmonies hazarded, which we do not recollect having seen in anterior contrapuntists, at least of our own country.

We dare proceed no further in analyzing the works of our illustrious countryman, though it would afford us great pleasure, as we never look at them without seeing a merit very superior to that of any of his contemporaries out of Italy, and even there, only the vocal compositions of Carissimi and Stradella seem to surpass them in grace and elegance. Carissimi appears to have been his model in his best recitatives, and Lulli in the worst; and it is manifest that he was fond of Stradella's manner of writing, though he never pillaged his passages.

We must not quit his vocal music without an honourable and grateful memorial of his catches, rounds, and glees, of which the humour, ingenuity, and melody, were so congenial with the national taste, as to render them almost the sole productions of the facetious kind that were in general use for near fourscore years. And though the countenance and premiums bestowed of late years upon this species of composition, as well as modern refinements in melody and performance, have given birth to many glees, of a more elegant, graceful, and exalted kind, than any which Purcell produced; yet he seems hardly ever to have been equalled in the wit, pleasantry, and contrivance of his catches.

Of fifteen anthems, with symphonies and instrumental parts, with innumerable odes and miscellanies, we have room to say nothing, though much praise is due to many of them.

An absurd custom prevailed in Purcell's time, which he carried to greater excess, perhaps, than any other composer, of repeating a word of one or two syllables an unlimited number of times, for the sake of the melody, and sometimes before the whole sentence has been heard. Such as *no, no, no*, —all, all, all—pretty, pretty, pretty, &c. *ad infinitum*. But there is equal redundancy and obscurity in the use which the Italians make at present of *sì, sì, sì*, and *nò, nò, nò*, in their songs.

Purcell was so little acquainted with the unlimited power of the violin, that we have scarcely ever seen a becoming passage for that instrument in any one of his works; the symphonies and ritornels to his anthems and songs being equally deficient in force, invention, and effect. And though his sonatas contain many ingenious, and, at the time they were composed, new traits of melody and modulation, if they are compared with the productions of his contemporary, Corelli, they will be called barbarous. But Corelli wrote for an instrument of which he was a great master: and who ever entirely succeeded in composing for one of which he was ignorant? When a great performer on keyed instruments condescends to compose for the violin, upon which he has never been a good player, or the voice, without knowing in what good fingering consists, the passages all come from the head, and none from the hand, except the hand of a harpsichord player, which is ever unfit to suggest ideas either for a voice, or for any other instrument than his own. Such a composer for the violin must inevitably embarrass the player with perpetual awkwardnesses and difficulties without effect, which discover an utter ignorance of the finger-board.

If Purcell, by travelling, or by living longer at home, had heard the great instrumental performers, as well as great singers, that arrived in this country soon after his decease, and had such to compose for, his productions would have been more regular, elegant, and graceful; and he would certainly have set English words better than it was possible for any foreigner to do, for our feelings, however great his genius, or excellent, in other respects, his productions. But Purcell, like his successor, Arne, and others who have composed for the playhouse, had always an inferior band to the Italian opera composers, as well as inferior singers, and an inferior audience to write for.

The diligent and candid Walther, by not having assigned to Purcell a niche in his Musical Dictionary, seems never to have heard of his existence; but Purcell was so truly a *national* composer, that his name was not likely to be wasted to the continent; and the narrow limits of his fame may be fairly ascribed, not only to the paucity and poverty of his compositions for instruments, for which the musical productions are an intelligible language to every country, but to his vocal compositions being solely adapted to English words, which render it unlikely for their influence to extend beyond the soil that produced them.

We should, however, have known as little of Lulli, as the French or Italians of Purcell, but for the partiality which Charles II. acquired, by his long residence on the continent, for the arts and amusements of France. The first attempts at operas here, after the Restoration, were either in French, or on the model of those that were then in high favour at Versailles. And whoever is equally acquainted with the recitative, we had almost said the general melody of Lulli and Purcell, must perceive a strong resemblance.

Purcell, however, having infinitely more fancy, and, indeed, harmonical resources, than the Frenchified Tuscan, his productions now afford far greater pleasure and amusement to a liberal lover of music, than can be found, not only in the productions of Cambert and Grabu, whom Charles II. and to flatter his majesty, Dryden, patronized in preference to Purcell, but in all the noisy monotony of the rhapsodist of Quinault.

Let those who shall think Purcell has sacrificed the national honour by confessing his reverence for the productions of Italy, compare the secular productions of English musicians, from the death of queen Elizabeth to the year 1683, with those of Carissimi, Cesti, Stradella, and innumerable others of great abilities, and if they do not equally hate

music and truth, they will admire Purcell's probity, as well as his genius.

Indeed, music was manifestly on the decline, in England, during the seventeenth century, till it was revived and invigorated by Purcell, whose genius, though less cultivated and polished, was equal to that of the greatest masters on the continent. And though his dramatic style and recitative were formed in a great measure on French models, there is a latent power and force in his expression of English words, whatever be the subject, that will make an unprejudiced native of this island feel, more than all the elegance, grace, and refinement of modern music less happily applied, can do. And this pleasure is communicated to us, not by the symmetry or rhythm of modern melody, but by his having fortified, lengthened, and tuned, the true accents of our mother-tongue; those notes of passion, which an inhabitant of this island would breathe, in such situations as the words he has to set describe. And these indigenous expressions of passion Purcell had the power to enforce by the energy of modulation, which, on some occasions, was bold, affecting, and sublime.

These remarks are addressed to none but Englishmen: for the expression of words can be felt only by the natives of any country, who seldom extend their admiration of foreign *vocal* music, farther than to the general effect of its melody and harmony on the ear; nor has it any other advantage over *instrumental*, than that of being executed by the human voice, like *solfeggi*. And if the Italians themselves did not come hither to give us the true expression of their songs, we should never discover it by study and practice.

It has been extremely unfortunate for our national taste and our national honour, that Orlando Gibbons, Pelham Humphrey, and Henry Purcell, our three best composers during the last century, were not blessed with sufficient longevity for their genius to expand in all its branches, or to form a school, which would have enabled us to proceed in the cultivation of music without foreign assistance.

Orlando Gibbons died 1625, at forty-four.

Pelham Humphrey died 1674, at twenty-seven.

And Henry Purcell died 1695, at thirty-seven.

If these admirable composers had been blessed with long life, we might have had a music of our own, at least as good as that of France or Germany; which, without the assistance of the Italians, has long been admired and preferred to all others by the natives at large, though their princes have usually foreigners in their service. As it is, we have no school for composition, no well-digested method of study, nor, indeed, models of our own. Instrumental music, therefore, has never gained much by our own abilities; for though some natives of England have had hands sufficient to execute the productions of the greatest masters on the continent, they have produced but little of their own that has been much esteemed. Handel's compositions for the organ and harpsichord, with those of Scarlatti and Alberti, were our chief practice and delight for more than fifty years; while those of Corelli, Geminiani, Albinoni, Vivaldi, Teffarini, Veracini, and Tartini, till the arrival of Giardini, supplied all our wants on the violin, during a still longer period. And as for the hautbois, Martini and Fisher, with their scholars and imitators, are all that we have listened to with pleasure.

If a parallel were to be drawn between Purcell and any popular composer of a different country, reasons might be assigned for supposing him superior to every great and favourite contemporary musician in Europe.

Carissimi and Stradella, if more polished in their style, were certainly less varied, and knew still less of instruments, than

than our countryman. They had both, perhaps, more grace and regularity, but infinitely less passion and fire.

The elder Scarlatti was more *recherché* and learned, but never so natural and effecting.

In Germany, if Keiser, during an active and much longer life, surpassed him in the number and excellence of his dramatic compositions, his productions for the church, could they be found, would, we believe, bear no comparison.

Lulli, blest likewise with superior longevity, composed also more operas than Purcell, and was the idol of the nation for which he laboured; but though his overtures long served as models, even to Purcell, as well as to the composers of all the rest of Europe, and his music was performed by better fingers, and a more numerous band, supported by the patronage of a court, and all the splendour of ingenious and costly exhibition; it is easy to see that even his theatrical works are more *manières*, monotonous, and uninteresting in themselves, than those of Purcell; but in relinquishing the stage, and stepping on holy ground, we should have found, even in France, during all his glory, and the enthusiasm he raised, none of his votaries who would attempt to put his sacred music in comparison with that of our countryman.

Rameau, the successor of Lulli in court and popular favour, and who had more learning and theoretical knowledge in the art, than perhaps any practical musician of modern times; yet, in pathos and expression of words and the passions, he was Purcell's inferior, even upon the stage; and in the church, he had no claim to celebrity.

Handel, who flourished in a less barbarous age for his art, has been acknowledged his superior in many particulars; but in none more than the art and grandeur of his choruses, the harmony and texture of his organ fugues, as well as his great style of playing that instrument; the majesty of his hautbois and grand concertos, the ingenuity of the accompaniments to his songs and choruses, and even in the general melody of the airs themselves; yet in the accent, passion, and expression of *English words*, the vocal music of Purcell is, sometimes to our feelings, as superior to Handel's as an original poem to a translation.

PURCHAS, SAMUEL, was born at Thaxted, in Essex, in 1577. He was educated at Cambridge, and was presented to a vicarage in his native county. This cure he resigned to his brother, and came to live in London, for the purpose of conducting the great work he had undertaken. The first volume folio appeared in 1613, under the title of "Purchas his Pilgrimage, or Relations of the World and the Religions observed in all Ages and Places discovered from the Creation unto this Present:" the other four volumes were published in 1625. To these the general title is "Hakluytus Posthumus, or Purchas his Pilgrims: containing a History of the World in Sea-voyages and Land-travels by Englishmen and others:" the name of Hakluyt is introduced, because Purchas became possessed of the papers which he left behind him. This great work, of which the object is to connect ancient and modern history, was well received, but probably involved the author in debt. He had been collated to the rectory of St. Martin's Ludgate, and was chaplain to Abbot, archbishop of Canterbury. He died about the year 1628, at the age of fifty-one. Biog. Brit.

PURCHASE, in *Law*, in its largest and most extensive sense, is defined by Littleton to be the possession of lands and tenements, which a man hath by his own act or agreement, and not by descent from any of his ancestors or kindred. In this sense, it is contradistinguished from acquisition by right of blood, and includes every other method of coming to an estate, but merely that by inheritance; in

which the title is vested in a person, not by his own act or agreement, but by the single operation of law. (Co. Litt. 18.) Purchase, in its vulgar and confined acceptation, is applied only to the acquisition of goods, lands, tenements, or the like, by means of money, or some other valuable consideration.

What we call *purchase*, *perquisitio*, the feudists call *conquest*, *conquestus*, or *conquisitio*, (see CONQUEST); both denoting any means of acquiring an estate out of the common course of inheritance; and this is still the proper phrase in the law of Scotland. The difference, in effect, between the acquisition of an estate by descent and by purchase, consists principally in these two points. 1. That by purchase the estate acquires a new inheritable quality, and is descendible to the owner's blood in general, and not the blood only of some particular ancestor. 2. An estate taken by purchase will not make the heir answerable for the acts of the ancestor, as an estate by descent will. According to this legal signification of the word *perquisitio*, or purchase, it includes the five following methods of acquiring a title to estates, viz. *escheat*, *occupancy*, *prescription*, *forfeiture*, and *alienation*, conveyance, or purchase, in its limited sense: under which latter head may be comprised any method in which estates are voluntarily resigned by one man, and accepted by another: whether that be effected by sale, gift, marriage-settlement, devise, or other transmission of property, by the mutual consent of the parties. See the several articles, and TITLE.

Natural persons, incorporate persons, sole or aggregate, deaf, dumb, and blind persons, minors, and all reasonable creatures, may purchase, except in some cases; but some have capacity to purchase, and not to hold, as aliens, felons, &c.; and others have ability to hold or not to hold upon a purchase, at the election of themselves or others, as infants, and feme coverts. 1 Inst. 2, 3. 11 Rep. 77. 7 Rep. 17.

PURCHASE and value of land. See VALUATION of Land, and POLITICAL Economy.

PURCHASE of writs. See WRIT.

PURCHASE, in the *Sea Language*, has the same signification with *draw in*, at land. Thus, they say, the capstern purchases apace, *i. e.* draws in the cable apace; and when they cannot draw or hale any thing in with the tackle, they say, the tackle will not purchase.

PURCHASE is also a name given by sailors to any mechanical power employed in raising or removing heavy bodies, or in fixing or extending the ship's rigging. Such are the tackles, windlasses, capsterns, screws, and handspikes.

PURCHASE-Book, among *Traders*, is the name given to a book, which is a kind of journal, containing an account of all the purchases made, or things bought in the day.

PURCHASER, FIRST, *Perquisitor*, in *Law*, denotes the person who first acquired an estate to his family, whether the same was transferred to him by sale or by gift, or by any other method, except only that of descent. See DESCENT.

PURCHASING of Estates, in *Agriculture*, the business of buying landed property. In order to perform this sort of bargain with propriety, and to the best advantage, attention is necessary to be had to a great variety of circumstances of different kinds, which respect the nature, quality, situation, condition, value, and conveniences of the property. See VALUATION of Land.

But it is probably best done, when to any extent, by a surveyor or other person who is perfectly conversant with the nature of the business, and fully acquainted with the

real value of landed property in the district where the purchase may be situated or met with.

It has been observed by Mr. Marshall, that there are two methods of making bargains of this kind, the one by public biddings, the other by private treaty or contract: in either of which, a certain degree of caution is common prudence. In the former, however, the conditions being fixed, an accurate valuation is the best safeguard; and, in the latter, among honest men little more is required.

In purchasing by private contract, the particulars which may be previously required to be furnished by the seller, are the quantities of the several pieces of the lands which are on sale, together with the maps, or rough drafts, of the same; the tenure under which they are held; some assurance as to the title of the seller; and his right of alienation; the tenancy under which the several farms are let; and, if on lives, the ages of the nominees; if for a term of years, the number which are unexpired; if at will, the notices with which the tenants have been served, if any have been given.

An abstract of the covenants under which they are let; particularly of those which relate to taxes and repairs, to the expenditure of produce, to the ploughing of grasslands, &c. &c.

The existing rents and profits receiveable; whether for tenanted lands, appurtenances, or abstract rights; with the estimated value of the demesne, and the woodlands in hand; together with the estimated value of the timber growing upon the estate on sale; as well as of the minerals and fossils which it may contain.

The outgoing to which the estate is liable; the proposed time of the delivery of possession; the price and the mode of payment which are expected.

And next, it will be proper to set down the particulars of the instructions to be given to a surveyor, or other valuer, of the estate to be purchased. It will be right, however, to premise, that much, in this respect, depends on the probability of purchasing; and on the time which is allowed for making the estimate. In cases of sale by public auction, when there can be no certainty as to purchase, and where the time for valuation is limited, a rough estimate of each farm, and a general idea of the value of the timber and other appurtenances, may be all that can be prudently ascertained. But in a sale by private contract, where the refusal of an estate is granted, and time allowed for deliberate survey, a more minute investigation may be proper; especially where there is every reason to believe that a bargain will take place. For the same report will not only serve as a guide to the purchase, but will become a valuable foundation, on which to ground the future management of the estate. And for these and other reasons, a purchase by private contract is most to be desired by one who is not in the habit of personally attending public sales, and is unacquainted with the business of an auction room.

It may be noticed, that the particulars to be required from a surveyor, or surveyors, in these cases, are principally these: the rental value of each field or parcel of land, with the state in which it lies, as to arable, meadow, pasture, or woodland; the value of the timber and other appurtenances: the characteristic, and the state of management of each farm or tenement, with the eligibility of the occupier; together with the state of repair of buildings, gates, fences, water-courses, and roads, the amount of the encumbrances and outgoing. And, lastly, the probable value of the improvements of which the estate may appear to be capable; whether by the several means that are commonly practised, or by new regulations and improved modes

of agricultural management, that may admit of being introduced.

It is added, that these several particulars of information being procured, the subjects of treaty are few. The two statements having being duly compared, so that no misunderstanding can take place between the parties, the price, and the times and mode of payment, are the principal matters of agreement. A clear understanding respecting the custody of title deeds and the expences of conveyance, require, however, to be enumerated among the preliminaries of purchase.

In these transactions, it is also supposed, the business of negotiation is best carried on by letters; which become vouchers of facts. Whatever is done by interview, requires to be reduced to writing, and to be read by or to the parties before they separate, that no possibility of misconception may arise. And, added to these precautions, it is proper in large purchases, and when abstracts of intricate title deeds are to be made out, and examined, that a legal contract or memorandum of agreement should be entered into, for the mutual satisfaction and surety of the parties. This contract and the deed of conveyance, which is the instrument which is legally to transfer the property from the seller to the purchaser, may be said to conclude and ratify the business of purchase. And in this part of it, legal assistance is essentially necessary; to examine existing deeds, and see that the seller has a legal right and clear title to the land, and a legal power to dispose of it; as well as to draw up or examine the fresh deed of conveyance, and see that it is sufficient to transfer the property legally and adequately to the purchaser.

PURCHENA, in *Geography*, a town of Spain, in the province of Grenada; 60 miles E. of Grenada. N. lat. $37^{\circ} 19'$. W. long. $2^{\circ} 30'$.

PURE, something free from any admixture of foreign or heterogeneous matters.

PURE Fire. See **FIRE**.

PURE Hyperbola, in *Conics*, is an hyperbola without any oval, node, spike, or conjugate point. See **CURVE**.

PURE Mathematics. See **MATHEMATICS**.

PURE Proposition. See **PROPOSITION**.

PURE Quadratics. See **QUADRATIC**.

PURE Resignations. See **RESIGNATION**.

PURE Villenage. See **VILLENAGE**.

PUREA, or **PURAN**, in *Geography*, a town of Chili; 80 miles S.S.E. of La Concepcion.

PUREEWAR, a town of Hindoostan, in Oude; 10 miles N. of Bahraitch.

PUREG, anciently *Pura*, once the capital of Gedrosia (Mekran), and termination of the toilsome march of Alexander towards the frontiers of Caramania, is now a mean village.

PURENDERA, in *Mythology*, a name of Indra, the Hindoo regent of the firmament. (See **INDRA**.) The word is said to mean *destroyer of towns*, the Indian Jupiter having, in revenge for sacrificial slights or negligences, frequently, according to the Hindoo books, assumed that character. The ancient city of Ougein, the capital of Malwa, was, according to tradition, destroyed by Indra. See **OUGEIN**.

PURESIL, in *Geography*, a town of Hindoostan, in the circar of Cicacole; 40 miles N.W. of Vizniagram.

PURETTA, a name given by some writers to the common shining black sand, used to strew over writing, and erroneously called by some *steel-dust*.

It is a natural mineral substance, found on the shores near Genoa, and in other places.

PURFLED,

PURFLED, ornamental work, whether in stone or other materials, representing embroidery or lace work.

PURFLEW, a term in *Heraldry*, expressing ermines, peans, or any of the furs, when they compose a border round a coat of arms.

Thus they say, he beareth gules a border, purslew, vairy ; meaning, that the border is vairy.

PURG, or **FORG**, in *Geography*, a town of Persia, in the province of Laristan ; 60 miles N.E. of Lar. N. lat. $28^{\circ} 30'$. E. long. $54^{\circ} 40'$.

PURGATION, **PURGATIO**, the act of purging, scouring, or purifying any thing, by separating and carrying off any impurities found therein.

PURGATION, in *Pharmacy*, is the cleansing of a medicine by retrenching its superfluities ; as taking the wood and seeds out of cassia, and the stones out of dates, tamarinds, and other fruits.

PURGATION is also used, in *Chemistry*, for several preparations of metals and minerals, intended to clear them of their impurities ; more usually called *purification* and *refining*.

The ordinary purgation of mercury is performed, by passing it through a chamois skin. (See **MERCURY**.) Gold is purged by the coppel, cementation, &c. See **GOLD**, **COPEL**, &c.

Purgation, in other metals, is performed by repeated fusion, &c.

PURGATION, *Catharsis*, in *Medicine*, the evacuation of the alimentary canal of its fecal contents, by means of substances which stimulate its fibres, and excite them to a more active peristaltic motion. Purgation is also sometimes carried farther, and, by causing a copious discharge of fluids from the exhalent vessels of the inner surface of the bowels, produces a considerable evacuation from the system at large. For an elucidation of the doctrine of purgation, see **CATHARTIC**.

PURGATION, in *Law*, is the clearing one's self of a crime, whereof publicly suspected or accused before a judge, called also *judicium Dei*.

Of these purgations there was anciently much use in England, especially touching matters of felony charged on clerks ; and there is something of them still retained in the ecclesiastical court on suspicion of incontinency, &c. Purgation is either *canonical* or *vulgar*.

PURGATION, *Canonical*, is that prescribed in the canon law, the form of which, obtaining in the spiritual court, is, that the party suspected shall take his oath that he is clear of the fact objected against him ; and bring so many of his honest neighbours, not above twelve, as the court shall assign him, to swear, on their consciences, that they believe he swears truly.

The canonical doctrine of purgation, whereby the parties were obliged to answer upon oath to any matter, however criminal, that might be objected against them, continued till the middle of the 17th century to be upheld by the spiritual courts ; when the legislature was obliged to interpose, to teach them a lesson of similar moderation. By the statute of 13 Car. II. cap. 12. it is enacted, that it shall not be lawful for any bishop, or ecclesiastical judge, to tender or administer to any person whatsoever, the oath usually called the oath *ex officio*, or any other oath whereby he may be compelled to confess, accuse, or purge himself of any criminal matter or thing, whereby he may be liable to any censure or punishment. But this doth not extend to oaths in a civil suit ; and, therefore, it is still the practice both in the spiritual courts, and in equity, to demand the personal answer of the party himself upon oath. Yet if in the bill any question be put, that tends to the discovery

of any crime, the defendant may thereupon demur, and refuse to answer. Anciently, upon the allowance of the benefit of clergy, the person accused was delivered to the ordinary, to make his purgation, which was to be before a jury of twelve clerks, by his own oath affirming his innocence, and the oaths of twelve compurgators as to their belief of it. But now, by the stat. 18 Eliz. cap. 7. this kind of purgation is also taken away ; and the person admitted to his clergy shall not be delivered to the ordinary.

PURGATION, *Vulgar*, being the most ancient manner, was by fire, or water, or combat ; used by infidels, and by Christians too, till abolished by the canon law. See **ORDEAL**, and **CORSNED**.

Combat, though now disused, may yet be still practised by the laws of the realm, in cases where evidence is wanting, and where the defendant rather chooses combat than any other trial. See **COMBAT**.

Terris bonis, &c. redhabendis post Purgationem. See **TERRIS**.

PURGATION, in *Rhetoric*, is used for that kind of defence which takes place when the accused person owns the fact, but denies that he did it with design, or with any bad intention.

PURGATION, in *Tragedy*, is a term which Aristotle uses for the effect of tragedy on the mind.

That philosopher observes, that tragedy, by means of the terror and compassion which it excites, purges passions out of the soul.

Indeed, Corneille adds, that tragedy frequently creates passions, instead of purging them ; so that he takes Aristotle's purgation to be no more than a chimera.

PURGATIONS, *Menstrual*, the catamenia or menses of women.

PURGATIVE, or **PURGING-Medicine**, a medicament, which evacuates the contents of the bowels by stool. See **CATHARTIC**.

PURGATORY, **PURGATORIUM**, in the Romish church, a place where the just are supposed to suffer the pains due to their sins, for which they have not satisfied in this world.

It is by the mercy of God, the indulgences of the church, and the prayers of the faithful, that people are supposed to be delivered out of purgatory.

This doctrine of purgatory, which some derive from the Platonic fancies of Origen, the Montanism of Tertullian, pretended visions, and pagan stories, rhetorical flourishes, and doubtful expressions of the later fathers, and in which we may discern an obvious resemblance to the famous pagan doctrine, concerning the purification of departed souls by means of a certain kind of fire, was partly introduced, at least in the spirit of it, towards the close of the fifth century, and by Gregory the Great in the sixth century ; but it was not, however, positively affirmed till about the year 1140, nor made an article of faith till the council of Trent. Sess. 25. Decret. de Purgat. See **PAPISTS** and **POPERY**.

In Ireland is a place called "St. Patrick's purgatory," where, as the legend has it, at the prayers of St. Patrick, bishop of the place, there was made a visible representation of the pains which the wicked undergo after death, in order to deter sinners, &c.

PURGATTY, in *Geography*, a town of Hindoostan, in the circar of Cicacole ; 40 miles N.W. of Vizniagram.

PURGE, in *Medicine*, a term frequently used for a dose of some purgative medicine.

PURGING ALE, *Butler's*. See **ALE**.

PURGING Grain, *Oily*, in *Botany*. See **SESAMUM**.

PURGING Nut, in *Botany*. See **JATROPHA**.

PURGING Thorn. See **BUCKTHORN**.

PURGLITZ, or **KRZIWOKLAD**, in *Geography*, a citadel of Bohemia, in the circle of Rakonitz, where the royal treasures were anciently kept, and state prisoners confined; seven miles S.E. of Rakonitz.

PURGOT, a town of Hindoostan, in Coimbatore; 35 miles W. of Ardenelle.

PURGOW, a town of Hindoostan, in Baglana; 25 miles E.N.E. of Basleen.

PURGSTALL, a town of Austria; four miles N. of Scheibs.

PURIFICATION, in *Chemistry*, &c. the act of purifying or refining natural bodies; or of separating the faces and impurities from them.

For the methods of purifying metals, gold, silver, iron, copper, tin, &c. see **GOLD**, **SILVER**, &c. and **REFINING**.

For the purification of semi-metals, minerals, and other matters, as antimony, sulphur, camphor, saltpetre, &c. see **ANTIMONY**, **SULPHUR**, **CAMPHOR**, &c.

PURIFICATION, in *Pharmacy*. See **TRYING**.

PURIFICATION, in *Matters of Religion*, denotes an offering made the priest by women rising out of child-bed, before they are re-admitted into the church.

By the law of Moses, a woman, after bringing forth a male child, was unclean forty days; after a female, eighty days; during which time, she was not to touch any thing holy, nor to go near the temple, but was to continue within doors, separate from all company, and commerce of others.

This term expired, she was to present herself at the temple, and at the door of the tabernacle, to offer a lamb, as an holocaust, and a pigeon or turtle; which the priest taking, offered to God, and prayed for her, that she might be purified.

This ceremony, which consisted of two things, an holocaust, and a sacrifice of expiation, was called טהרה טהרה, *purificatio, purgatio*.

The holy Virgin, though, according to the fathers, exempt from the terms of the law, yet complied with it, and, at the time prescribed, went to the temple, and accomplished the law; in commemoration of which the church yearly solemnizes the feast of the Purification of the Virgin, on the second of February; called also the Feast of Candlemas.

PURIFICATION, *The Feast of the*, seems to be very ancient. It is ordinarily said to have been instituted in the time of Justinian, in the year 542, and this on occasion of a mortality, which that year dispeopled almost the whole city of Constantinople. Yet there are some, who imagine it to have been observed before, though in another manner, and on a different day from that fixed by Justinian; viz. between the Circumcision and Epiphany. See **CANDLEMAS**.

The same day is the presentation of our Saviour in the temple.

PURIFICATION, in *Geography*, a town of Mexico, in the province of Xalisco; eight miles S. of Compostella Nuova. N. lat. 19° 58'. W. long. 105° 46'.

PURIM, a solemn feast held among the Jews on the fourteenth and fifteenth of March, in memory of their deliverance from the conspiracy of Haman by Esther. See **ESTHER**.

This feast, which derives its name from the Persian word *purim*, q. d. *lots*, because it was by the casting of lots that Haman determined this time for the destruction of the Jews, is the Bacchanals of these people, which they celebrate with all manner of rejoicing, mirth, and jollity; indulging themselves with every kind of luxury, especially in drinking wine even to drunkenness, which they consider as part of the duty of the solemnity; because it was by means of the wine

banquet (they say) that Esther made the king's heart merry, and brought him into that good humour, which inclined him to grant the request presented by her for their deliverance; and, therefore, they think they ought also to make their hearts merry, when they celebrate the commemoration of it. During this festival the book of Esther is solemnly read in all their synagogues from the beginning to the end, at which they are all to be present, men, women, children, and servants, because all shared in the benefit of the deliverance which Esther obtained for them. And as often as the name of Haman occurs in the reading of this book, the custom is for all to clap with their hands, and stamp with their feet, and cry out, Let his memory perish. Pridcaux's Conn. vol. ii. p. 456.

PURITANS, in *Ecclesiastical History*. See **CATHARI** and **NOVATIANS**.

PURITANS is also a term anciently used for the Calvinists of Great Britain, from their professing to follow the pure word of God, in opposition to all traditions, human constitutions, and other authorities.

The separation, whence this distinguishing appellation took its rise, commenced on the following occasion. Upon the accession of queen Mary, it is well known that popery revived in this kingdom; the statutes of king Edward were repealed, and the penal laws against heretics were put in execution against the reformers. Many suffered at home; and others escaped the fury of persecution by seeking refuge in foreign countries. Some went into France and Flanders; some to Geneva; and others into those parts of Germany and Switzerland, where the reformation had taken place, and where the magistrates received them with great humanity, and allowed them places for public worship. The exiles were most numerous at Frankfort; and there that contest and division began, which gave rise to the Puritans, and to that separation from the church of England, which continues to this day. In the year 1554, some of the English fugitives settled in this city; and agreed to conduct their worship, without answering aloud after the minister, and without using the liturgy and surplice; to begin the public service with a general confession of sins, then to sing a psalm, after which the minister prayed for the divine assistance, and next proceeded to the sermon; after sermon, a general prayer for all estates, and particularly for England, at the end of which was subjoined the Lord's prayer, and a rehearsal of the articles of belief; then the people were to sing another psalm, and the minister to dismiss them with a blessing. Such was the order which they had unanimously adopted; and having chosen a minister and deacons, they invited their dispersed brethren to join with them. In the year 1556, Dr. Cox, afterwards bishop of Ely, came to settle at Frankfort with several of his friends; who interrupting the public service by answering aloud after the minister, and reading the whole litany, in violation of the agreement upon which the congregation was formed, overpowered the first settlers; and obtaining leave of the magistrates for the free use of king Edward's service-book, performed divine worship according to the rites that had been authorized by that prince; while others, who preferred the Genevan method of worship, as more pure and simple, left the city of Frankfort, and removed to Basil and Geneva. Thus commenced the distinction of Puritans and Conformists, by which the two parties were afterwards known. The former were called Conformists, on account of their compliance with the ecclesiastical laws enacted by Edw. VI. and the denominations of Nonconformists and Puritans were given to the latter, from their insisting upon a form of worship, more exempt from superstition, and of a purer kind than

than the liturgy of Edward seemed to them to be. Upon the accession of queen Elizabeth, the exiles returned to England, where each party strove to advance the reformation according to their own standard. The queen, with those who had weathered the storm at home, were only for restoring king Edward's liturgy; but the majority of the exiles were for the worship and discipline of the foreign churches, and refused to comply with the old establishment, declaiming loudly against the popish habits and ceremonies. However, the queen's party prevailed; and in 1559 a committee of divines was appointed to review king Edward's liturgy, who were instructed to strike out all offensive passages against the pope, and to make people easy about the belief of the corporal presence of Christ in the sacrament. But no alterations were made in favour of those who now began to be called Puritans, from their attempting a purer form of worship and discipline than had yet been established; and whose sentiments in many points were agreeable to those maintained by John Wickliffe, the first reformer. For they agreed with him in opinion, that in the sacrament of orders there ought to be but two degrees, presbyters or bishops, and deacons; that all human traditions are superfluous and sinful; that we must practise and teach only the laws of Christ; that mystical and significant ceremonies in religious worship are unlawful; and that to restrain men to a prescribed form of prayer is contrary to the liberty granted them by God. The old festivals, with their eves and the popish habits, were continued as they were in the second year of king Edward VI. In 1558 the act of supremacy was passed, in which there is a remarkable clause, that gave rise to the court of high-commission, which proved afterwards so oppressive; and in 1559 was passed an act for the uniformity of common prayer, and service in the church, and administration of the sacraments. The Puritans remonstrated against these proceedings, and complained, that the gross superstitions of popery, which they had looked upon as abrogated and abolished, were now revived, and even imposed by authority. Some required nothing less than that the church of England should be exactly modelled after that of Geneva; others only desired liberty of conscience, with the privilege of celebrating divine worship in their own way; but neither party obtained the object of their wishes. The queen, intent upon the suppression of this troublesome sect (as she was used to call it), permitted its enemies to employ for that purpose all the resources of artifice, and all the severity of the laws. The court reformers pleaded, that every prince had authority to correct all abuses of doctrine and worship within his own territories; the Puritans, on the other hand, whilst they disowned all foreign authority and jurisdiction over the church, could not admit of that extensive power which the crown claimed by the supremacy; apprehending it unreasonable, that the religion of a whole nation should be at the disposal of a single lay person. However, they took the oath, with the queen's explication in her injunctions, as restoring her majesty only to the ancient and natural rights of sovereign princes over their subjects.

Farther, the court reformers allowed, that the church of Rome was a true church, though corrupt in some points of doctrine and government; that all her ministrations were valid, and that the pope was a true bishop of Rome, though not of the universal church. But the Puritans affirmed the pope to be antichrist, the church of Rome to be no true church, and all her ministrations to be superstitious and idolatrous; they renounced her communion, and durst not suspend the validity of their ordinations upon an interrupted line of succession from the apostles through her hands.

Moreover, it was agreed by all, that the holy scriptures were a perfect rule of faith; but the bishops and court reformers did not allow them to be the standard of discipline or church government; affirming that our Saviour and his apostles left it to the discretion of the civil magistrate, in those places where Christianity should obtain, to accommodate the government of the church to the policy of the state. But the Puritans apprehended the holy scriptures to be a standard of church discipline as well as of doctrine; at least that nothing should be imposed as necessary but what was expressly contained in, or derived from them by necessary consequence, and, besides, they maintained that the discretionary power was not lodged with the civil magistrate, but with the spiritual officers of the church. Farther, the court reformers maintained, that the practice of the primitive church for the first four or five centuries was a proper standard of church government and discipline, and in some respects a better than that of the apostles, which (according to them) was only accommodated to the infant state of the church while it was under persecution, whereas theirs was suited to the grandeur of a national establishment. Whereas the Puritans were for adhering to the bible in the main principles of church government, and for admitting no church officers or ordinances, but such as are herein mentioned; and they apprehended, that the apostles, in establishing the first Christian church on the aristocratical plan then observed in the Jewish sanhedrim, designed it as an unchangeable model to be followed in all times and places. The court reformers also maintained, that things indifferent in their own nature, which are neither forbidden nor commanded in the holy scriptures, such as rites, ceremonies, habits, &c. might be settled, determined, and made necessary by the command of the civil magistrate, and that in such cases it was the indispensable duty of all subjects to observe them. But the Puritans insisted, that those things which Christ had left indifferent, ought not to be made necessary by any human laws, and that such rites and ceremonies as had been abused to idolatry, and had a manifest tendency to lead men back to popery and superstition, were no longer indifferent, but to be rejected as unlawful. Nevertheless, both parties agreed too well in asserting the necessity of an uniformity of public worship, and of calling in the sword of the magistrate for the support and defence of their several principles; which they made an ill use of in their turns, as they could grasp the power into their hands. The standard of uniformity, according to the bishops, was the queen's supremacy, and the law of the land; according to the Puritans, the decrees of provincial and national synods, allowed and enforced by the civil magistrate; but neither party was for admitting that liberty of conscience, and freedom of profession, which is every man's right, as far as is consistent with the peace of the government under which he lives.

In the year 1564, upon a report that the habits, enjoined on the clergy, were generally neglected, and also of inattention to other imposed forms, the queen directed the ecclesiastical commissioners to consult some proper methods to reduce them to an exact uniformity; upon which they agreed on certain *advertisements* (as they were called), partly for due order in preaching and administering the sacraments, and partly for the apparel of ecclesiastical persons. To these advertisements certain protestations were annexed, to be made, promised, and subscribed by such as should hereafter be admitted to any office or cure in the church. The queen, though she would give no authority to the advertisements, which had occasioned much remonstrance and complaint, issued out a proclamation in 1565, peremptorily requiring

quiring uniformity in the habits, upon pain of prohibition from preaching, and deprivation. Parker, the archbishop of Canterbury, was violent and unrelenting; and by various methods of severity, harassed, silenced, and deprived many of those who scrupled the use of the habits. The suspended ministers, finding that renewed applications to the queen and her commissioners were ineffectual, published, in 1566, a small treatise in vindication of their conduct; in which they allege, that neither the prophets of the Old Testament, nor the apostles of the New, were distinguished by their garments; that a distinction of garments in the Christian church did not generally obtain till long after the rising of antichrist; that the garments against which they objected, had been abused to idolatry, sorcery, and all kinds of conjurations; that they were an offence to weak Christians, an encouragement to ignorant and obstinate papists, and the use of them an affectation of returning to their communion; that at best they were only human appointments, subject to the apostle's reproof, Col. ii. 20—22; that allowing them to be indifferent (which they did not grant), yet they ought not to be imposed, because it was an infringement of the liberty with which Christ had made them free; and finally they urged the suffrage of foreign divines, who all condemned the habits, though they were not willing to hazard the reformation in its infancy, on account of them.

If, at this time, the habits and a few ceremonies had been left indifferent, both ministers and people would have acquiesced; but it was the compelling of these things by law that made them separate from the established church. Accordingly, in 1566, they came to a resolution, alleging it to be their duty, in their present circumstances, to break off from the public churches, and to assemble, as they had opportunity, in private houses, or elsewhere, to worship God in a manner that might not offend against the light of their consciences; and it was debated among them, whether they should use as much of the common prayer and service of the church as was not offensive, or resolve at once, since they were cut off from the church of England, to set up the purest and best form of worship, most consonant to the holy scriptures, and to the practice of the foreign reformers. The latter of these measures was concluded upon; and accordingly they laid aside the English liturgy, and made use of the Geneva service-book. However, it is necessary to observe, that though all the Puritans of these times would have remained in the church, if they might have been indulged in the habits and a few ceremonies, yet they were far from being satisfied with the hierarchy. They had other objections besides those for which they were deprived; of which we shall here subjoin a summary. They complained of the bishops affecting to be thought a superior order to presbyters, and claiming the sole right of ordination, and the use of the keys; and assuming, in connection with their office, temporal dignities, titles, and employments. As long, however, as the English bishops pretended to derive their dignity and authority from no other source than the laws of their country, and pleaded a right, merely human, to the rank they held in the church and state, the controversy was carried on without excessive animosity and zeal; but the flame broke out with redoubled fury in the year 1588, when Bancroft, afterwards archbishop of Canterbury, ventured to assert that the order of bishops was superior to the body of presbyters, not in consequence of any human institution, but *jure divino*, or by the express appointment of God himself. Farther, the Puritans excepted against the titles and offices of archdeacons, deans, chapters, and other officials, belonging to cathedrals, as having no foundation in scripture, or primitive antiquity, and intrenching upon the

privileges of the presbyters in the several dioceses. They complained of the exorbitant power and jurisdiction of the bishops and their chancellors in their spiritual courts, as derived from the canon law of the pope, and not from the word of God, or the statute law of the land. They lamented the want of a godly discipline, and were uneasy at the promiscuous and general access of all persons to the Lord's table. Though they did not dispute the lawfulness of set forms of prayer, provided a due liberty was allowed for prayers of their own compoſure before and after sermon, yet they disliked the frequent repetition of the Lord's prayer in the liturgy, the interruption of the prayers by the frequent responses of the people, some passages in the office of marriage, as *With my body I thee worship*, and in that of burial, as *In ſure and certain hope of the reſurrection to eternal life*, pronounced over the work of men, if not excommunicated, &c. They also objected against the reading of the apocryphal books in the church, while some parts of canonical scripture were omitted; and though they did not dislike the homilies, they thought that no man should be ordained a minister in the church who was not capable of preaching and expounding the holy scriptures. They disapproved of several of the church festivals or holidays, as having no foundation in scripture, or primitive antiquity; and they disallowed of the cathedral mode of worship; nor did they approve of musical instruments in the church service. Finally, they scrupled conformity to certain rites and ceremonies, which were enjoined by the rubric, or the queen's injunctions; as the sign of the cross in baptism, baptism by midwives, or other women, in cases of sickness, and the mode of churching women; the use of god-fathers and god-mothers, to the exclusion of parents from being sureties for the education of their own children; the custom of confirming children, as soon as they could repeat the Lord's prayer and their catechism, by which they had a right to come to the sacrament, without any other qualification, and the imposition of hands, as a sign of the divine favour, which seemed to them to imply a sacramental efficacy in this ceremony; kneeling at the sacrament of the Lord's supper, whilst they considered that Christ gave it to his disciples rather in a posture of feasting than of adoration; that it had no foundation in antiquity; that it had been grossly abused by the papists to idolatry in their adoration of the host; and that, if the posture were indifferent, it ought not to be imposed as a necessary term of communion; nor did they approve of administering either of the sacraments in private, even in cases of danger; bowing at the name of Jesus; giving the ring in marriage, which they considered as derived from the papists, who made marriage a sacrament, and the ring a sort of sacred sign or symbol; the prohibition of marriage during certain times of the year, and the licensing it for money; and, lastly, the wearing of the surplice, and other vestments to be used in divine service.

In points of doctrine there was, at this time, no difference between the Puritans and Conformists; and if we add one article more to the preceding, we shall have the principal heads of controversy between the church of England and the Protestant Dissenters, at this day; *viz.* the natural right which every man has to judge for himself, and make profession of that religion he apprehends most agreeable to truth, as far as it does not affect the peace and safety of the government under which he lives; without being determined by the prejudices of education, the laws of the civil magistrate, or the decrees of councils, churches, or synods. See *PROTESTANT DISSENTERS*.

Towards the latter end of queen Elizabeth's reign, there arose a party, which were first for softening, and then for overthrowing,

overthrowing, the received opinions concerning predestination, perseverance, free-will, effectual grace, and the extent of Christ's redemption. The clergy of the episcopal church began to lean towards the notions concerning these intricate points, which Arminius propagated some time after this; while on the other hand, the Puritans adhered rigorously to the system of Calvin. Several episcopal doctors remained attached to the same system in the reign of James I. &c. and all these abettors of Calvinism, whether episcopal or presbyterian, were called *doctrinal* Puritans. At length, according to Mr. Fuller, (Church Hist. book ix. p. 97. book x. p. 100.) the name was extended to stigmatize all those who endeavoured in their devotions to accompany the minister with a pure heart, and who were remarkably holy in their conversation; so that a Puritan was a man of severe morals, a Calvinist in doctrine, and a Non-conformist to the ceremonies and discipline of the church, though he did not totally separate from it.

Queen Elizabeth was violent in her opposition to the Puritans through the whole course of her reign; and besides the ordinary courts of the bishops, she erected, as we have already observed, a new tribunal, called the court of high-commission, which suspended and deprived men of their livings, not by the verdict of twelve men upon oath, but by the solemn determination of three commissioners of her own nomination, founded not upon the statute law of the realm, but upon the canon law; and instead of producing witnesses in open court to prove the charge, they assumed a power of administering an oath *ex officio*, by which the prisoner was obliged to answer all questions the court should put to him, though never so prejudicial to his own defence. If he refused to swear, he was imprisoned for contempt; and if he took the oath, he was convicted upon his own confession.

During the reign of James I. from whom the Puritans expected more indulgent treatment, they were treated with great severity, and many of them were obliged to leave the kingdom, and retire to Holland; and from thence considerable numbers migrated to America in the year 1620. All were Puritans, in the estimation of king James, who adhered to the laws of the land in opposition to his arbitrary government, though otherwise ever so good churchmen. These were called *Puritans in the state*; and those who scrupled the ceremonies, and adhered to the doctrines of Calvin, were *Church* Puritans, who, though comparatively few, yet being joined by those of the other class, became the majority of the nation. The success that attended the first emigrators, who settled in that part of America afterwards called New Plymouth, engaged great numbers of Puritans, who groaned under the oppression of the bishops, and the severity of a court, by which this oppression was authorized, to follow the fortunes of these religious adventurers; and this produced a second emigration in the year 1629, which gave birth to the second grand colony, commonly known by the name of the Massachusetts's Bay. The colony of Connecticut was formed by emigrants of the same class in 1636, and that of New Haven in 1637, who fled from the persecution of Laud, and the oppressions of the star-chamber and high-commission courts. Afterwards, when the Puritans were not allowed to transport themselves to New England, many of them removed, with their families, into the Low Countries.

After the restoration of Charles II. in the year 1662, the name of Puritans, says bishop Burnet, was changed into that of Protestant Non-conformists, who were subdivided into Presbyterians, Independents, Anabaptists, and Quakers. At this time a public law, called the Act of Uniformity, was enacted, by which all who refused to observe the rites,

and subscribe the doctrines of the church of England, were entirely excluded from its communion. From this period until the reign of king William III. the Non-conformists were in a precarious and changing situation, sometimes involved in calamity and trouble, and at other times enjoying some intervals of tranquillity and certain gleams of hope, according to the varying spirit of the court and ministry, but never entirely free from perplexities and fears. But in the year 1689, their affairs took a favourable turn, when a bill for the toleration of all Protestant Dissenters from the church of England, except the Socinians, passed in parliament, almost without opposition, and delivered those who could comply with the conditions it imposed, from the penal laws to which they had been subjected by the act of uniformity, and other acts passed under the house of Stuart. For the present state of the toleration, see TOLERATION. See also CORPORATION *AN* and TEST. Neal's Hist. of the Puritans, in 4 vols. 8vo. passim.

PURITY, in *Oratory*, is one of the constituent parts of elegance, and denotes the choice of such words and phrases as are suited and agreeable to the use of the language in which we speak. Grammarians reduce the faults which they oppose to it to two sorts, which they call barbarism and solecism; the former of which respects single words, and is an offence against etymology, and the reproach of it is incurred by the use of words entirely obsolete, by the use of words entirely new, or by new formations and compositions, from simple and primitive words in present use. The latter respects the construction of words, and is an offence against syntax: to which Dr. Campbell adds a third class of faults, under the denomination of *impropriety*, which is an offence against lexicography, the business of which is to assign to every word of the language the precise meaning or meanings which use hath assigned to it. This impropriety occurs both in single words and in phrases. Dr. Ward recounts the principal things that vitiate the purity of language. It often happens, he says, that such words and forms of speaking, as were introduced by the learned, are afterwards dropped by them, as mean and fordid, from a seeming baseness contracted by vulgar use: and it is common to language, with all other human productions, that it is in its own nature liable to a constant change. (Hor. Art. Poet. v. 68.) We must, therefore, no less abstain from antiquated, or obsolete words and phrases, than from fordid ones. On the other hand, we should refrain from new ones, or such, whose use has not been yet sufficiently established, at least among those of the best taste. Besides, any mistake in the sense of words or their construction, is opposed to purity: for to speak purely is to speak correctly. And farther, a distinction ought to be made between a poetic diction, and that of prose writers: for poets in all languages have a sort of peculiar dialect, and take greater liberties, not only in their figures, but also in their choice and disposition of words: so that what is a beauty in them, would often appear unnatural and affected in prose. Ward's Or. vol. i. p. 308, &c. Campbell's Phil. of Rhet. vol. i. p. 409, &c.

PURKI, in *Geography*, a town of Hindoostan, in Bahar; 33 miles N. of Ramgur.

PURLIEU. See PURLOE.

PURLIEU-WOODS, such as formerly constituted parts of the royal forests, but of which the owners have obtained grants from the crown, and permission to disforest them, and which not being now subject to any of the laws or regulations by which different interests in forest woods are conducted, may, Mr. Donaldson says, be to all intents and purposes considered as private property. And, he adds, that

that the manner in which these woodlands are occupied is exactly the same as that of many of the royal forests, with the exception of the right of pasturage, and for that reason much more productive and beneficial. See Woods and ROYAL Forests.

PURLINS, in *Building*, those pieces of timber that lie across the rafters on the inside, to keep them from sinking in the middle of their length.

PURLUE, **PURLIEU**, or **POURALLEE**, formed from the French *pur*, *pure*, and *lieu*, *place*, is all that ground near any forest, which, being added to the ancient forest by our kings, was, by perambulation, granted by some of their successors, severed again from the same, and made purlieu, *i. e.* pure and free from the laws and obedience of the forest.

A purlieu, or pourallee, is defined a circuit of ground adjoining to the forest, and circumscribed with immovable boundaries, known only by matter of record; which compass of ground was once forest, and afterwards was disafforested by the perambulations made for severing the new forest from the old.

Purlieus, or pourallees, commenced after the manner following. King Henry I. at his accession to the crown in 1154, took so much delight in the forests of this kingdom, that, not being contented with those he found here, though many and large, he began to enlarge divers of them, and to afforest the lands of his subjects nearly adjoining to the same.

His successors, Henry II. and Richard I., far from retrenching or restoring any thing, made still farther encroachments: and thus did the lands continue till the 17th year of king John; at which time, the grievance being grown notorious, and generally felt by all degrees of people, divers noblemen and gentlemen besought the king to grant, that they might have all those new afforestations made by his predecessors aforesaid, and by himself, disafforested again; and the king, after much solicitation, was at length prevailed on to subscribe and seal such articles concerning the liberties of the forest, as they then demanded; being, for the most part, such as are now contained in the Charter of the Forest.

Hereupon choice was made of divers noblemen, &c. to the number of twenty-five, who were sworn, with others their assistants, to see the said liberties, so granted and confirmed by the king, to be in every point observed.

But, before any thing was done to the purpose, king John died; and king Henry III. succeeding, fresh solicitations were made to him; who, for the better accomplishing of the said disafforestation, ordered inquisitions to be taken, by substantial juries, for severing all the new forests from the old: upon which, two commissioners were sent to take those inquisitions; in virtue whereof, many great woods and lands were not only disafforested, but were improved to arable lands by the owners thereof. After this charter was made and confirmed, some of these new afforestations were perambulated, and proper inquisitions taken, and the certainty was determined by matter of record, which were the old, and which the new: though it appears, that the greatest part of the new afforestations were still remaining during the life of king Henry III.

Under Edward I. fresh petitions and solicitations being set on foot, three bishops, three earls, and three barons, were at length appointed to see those perambulations performed and continued; who caused them to be made accordingly, and inquisitions to be taken thereupon, and returned into the court of chancery; and all those that were ancient forest to be meered, and bounded with irremovable boundaries, to be known by matter of record for ever.

Those woods and lands, that had been newly afforested,

the king likewise caused to be separated from the old, and to be returned into the chancery by marks, meres, and bounds, to be known in like manner by matter of record for ever.

Thus it appears how the purlieus, or pourallees, had their first beginning; for all such woods and lands as were afforested by Henry II. Richard I. or king John, and, by perambulations, severed from the ancient forests, were, and yet are, called *pourallees*, *q. d.* woods and lands severed from the old forests, and disafforested by perambulation; *pourallee* being the same as *perambulation*, in Latin.

But, notwithstanding such new afforestations were disafforested by perambulation, whereby the same became pourallee, or purlieu, yet they were not thereby so disafforested as to every man, but that they do, in some sense, continue forest still as to others. For, by the words of *Charta de Foresta*, if the king has afforested any woods or lands of his subjects, to the damage of the proprietors, they should forthwith be disafforested again; that is, only as to those persons whose woods and lands they were: who, as the proper owners thereof, might fell and cut down their woods at their own pleasure, without any licence from the king; as also convert their meadows and pastures into tillage, or otherwise improve their ground to the best advantage. So also they might hunt, and chase the wild beasts of the forest towards the same, &c. But no other person should claim such benefit of hunting in the pourallee, besides the proper owner of the soil thereof, who is left at liberty to suffer the pourallee to remain forest still, as some, in effect, have thought most expedient, because hereby entitled to the benefit of the common within the forest, which otherwise they were excluded from. Hence, if the beasts chance to wander out of the forest into the pourallee, the king hath a property in them still, against every man, but the owner of the ground wherein they are, who hath a special property in them, *ratione soli*; yet so as he may only take them by hunting, or chasing with his greyhounds or dogs, without any forestalling or forestetting them in their course again towards the forest.

Beside what hitherto has been said of the difference between forest and purlieu, or pourallee, there is this farther diversity, that all the woods and lands within the regard of the forest are absolutely within the bondage or charge of the forest, as well in respect to the owners thereof, as of any other person; for no one may cut down his own woods, or improve his own lands, within the regard of the forest, without licence from the king or his chief justice in eyre of the forest. Neither shall any person hunt, chase, or molest the wild beasts of the forest in his ground, within the regard of the forest, without licence or warrant from the king, or his chief justice of the forest so to do.

But those, whose grounds are within the pourallees, are not subject to these restrictions. Yet are not the woods and lands in the pourallees absolutely freed from the bondage of the forest, in respect of the wild beasts having their haunts therein, when they happen to stray out of the forest; but as they were once absolutely forest, so they are still conditionally so.

PURLUE-MAN, or **Purlieu-man**, or **Pourallee-man**, is one who has land within the purlieu; and is allowed or qualified to hunt or course within the same, though under certain restrictions.

By stat. 13 Ric. II. he who may lawfully hunt in any pourallee, ought to have woods or lands of freehold within the pourallee, to the yearly value of 40s. By stat. Jac. I. he ought to have lands of inheritance of the yearly value of 10*l.* or lands of freehold of the yearly value of 30*l.* or have

have goods worth 200*l.* or be the son of a knight or baron, or person of a higher degree, or son and heir apparent of an esquire. But, by a later act, Car. II. no man may keep greyhounds within the pourallee, or elsewhere, within England or Wales, unless he have a free warren, or be lord of a manor, or such a freeholder as is seised, in his own right, or in right of his wife, of lands, tenements, or hereditaments of the clear yearly value of 40*l.* over and above all charges and reprises of such estate of inheritance; or of lands, tenements, or hereditaments, in his own right, or in right of his wife, for term of life or lives, of the yearly value of 80*l.* over and above all charges and reprises, or that is worth in goods or chattels 400*l.*

The pourallee, or purlieu, then, is said to be for him that is so qualified: others, not qualified, and therefore not purlieu-men, yet having land in the pourallee, may, if they find any wild beasts of the forests in their own grounds within the pourallee, chase them thereout with little dogs; but not with greyhounds, or other dogs.

Nor is the purlieu-man left at large to hunt at his own discretion; but he is tied down to several rules: as,

1. That he always begins his chase in his own ground; and, that, though he finds such wild beasts in his own pourallee, and in respect thereof, hath a property in them, *ratione soli*, against all persons, but the king; yet such his property is only on this condition, that he can stay them with his dogs in chase, without forestalling them, before they can recover the forest. If they be within the list of the forest, before the dogs fasten on them, they are the king's, or other owner of the forest.

2. But if the pourallee-man first make his chase in his own freehold, he may pursue the same through every man's ground within the pourallee, and his dogs fasten on a wild beast, before he can get within the bounds of the forest, and the beast draw the dogs into the forest, and is there slain by them; here the pourallee-man shall not enter into the forest, nor take the beast so killed, because his course was irregular from the beginning, as he could claim no property in the beast, *ratione soli*.

3. A pourallee-man may hunt in his own pourallee with no more company than his own servants; neither may he appoint, license, or warrant any other person, except his servants, to hunt by his commandment in his pourallee.

4. Every pourallee-man is forbidden, by the laws of the forest, to hunt in his own grounds within the pourallee every day, or oftener than three days in any one week, Sunday excepted.

5. Nor is any man to disturb, or make a course after any deer found in his pourallee, within forty days after the king hath made a general hunting in the forest adjoining thereunto; because then the wild beasts of the forest come not into the pourallees of their own accord, but as they are forced into the same by the hunters, with clamours, and blowing of horns, so that they fly thither for refuge.

6. No man shall hunt within seven miles of the borders of the forest, or in his own pourallee, within forty days next before the king hath issued out his proclamation, declaring his royal will and pleasure to make a general hunting in that forest.

Inasmuch as the pourallees were once, and in some sense still are forest, it was necessary to have officers to attend, and take on them the charge of the preservation of the game that may happen to wander out of the forest into the pourallees; since otherwise the laws of the pourallees could not be executed, but the forest itself would soon be destroyed by the pourallee-men.

For this reason, rangers were first appointed, who,

though not officers in the forest, yet appertain thereto; for all officers in the forest have charge of the vert and venison of the forest; but a ranger hath no charge of the vert, but only of venison coming out of the forest, into the pourallees, his place of charge; from whence his office is to conduct the same back again into the forest.

This officer is appointed by the king, or his chief justice in eyre, and is made by patent, with a fee commonly of twenty, thirty, or forty pounds, or more, by the year, payable out of the exchequer, as also certain fee-deer, both red and fallow, to be taken annually, at proper seasons, out of the forest.

The substance of his oath is, to chase, and with his hounds drive back, the wild beasts of the forest, as often as they range out of the same into his pourallee; to prevent all unlawful hunting and hunters of wild beasts of venery and chase, as well within the pourallees, as within the forest; and to prevent those and other offences, at the next court of attachments or swaimote, which shall first happen.

Rangers, it is to be observed, belong only to such pourallees as were once the woods and lands of the subject, and were afterwards disafforested again, and so became pourallees. Hence, as there are some forests in England, which never had any enlargement by new afforestations, and therefore have no pourallees at this day, there can be no rangers belonging to them. Manwood's Forest Laws, part 2. c. 20. 4 Inst. 303, 4. 1 Jones's Rep. 278. Moor. 706. 987.

PURMALL, in *Geography*, a town of Hindoostan; 15 miles W.S.W. of Allahabad.

PURMERENT, a town of North Holland, on a brook of the same name, governed by a council, bailiff, and burgo-masters. The town had a voice in the assembly of the states; 10 miles N. of Amsterdam. N. lat. 52° 33'. E. long. 4° 46'.—Also, a small island near the coast of Java, on which lies an hospital for the diseased poor of Batavia.—Also, a small island in a large bay on the N. coast of New Guinea. S. lat. 2° 16'. E. long. 135° 12'.

PURNA. See PANNAH.

PURNEAH, a circar of Bengal, bounded on the N. by Morung, on the E. by Dinagepour, on the S. by Rajemal, and on the W. by Bahar; about 80 miles long from N.E. to S.W., and 70 from N.W. to S.E. The capital of the same name is situated on a river which runs into the Ganges; 200 miles N. of Calcutta. N. lat. 25° 48'. E. long. 87° 40'.

PURNITZ, a town of Moravia, in the circle of Iglau; 7 miles S.E. of Iglau.

PURPARTY (Fr. *pour part*, i. e. *pro parte*) is that part or share of an estate, first held in common by parceners, which is by partition allotted to any of them. To make purparty is to divide and sever the lands that fall to parceners, which till partition they held jointly, and *pro indiviso*. Old Nat. Br. 11.

PURPLE, PURPURA, πορφυρα, a red colour, bordering on violet; now dyed chiefly with cochineal.

Purple was much esteemed among the ancients; especially the Tyrian purple, which underwent more dyes than the rest, and which was almost peculiar to the emperors and kings. Yet this purple did not exceed that now in use. The chief reasons why the ancient purple dye has been disused are, that the latter is both cheaper and finer.

The ancient purple was tinged or given with the blood or juice of a precious turbinated testaceous sea-fish, called by the Greeks πορφυρα, and by the Latins *purpura*; of which we have descriptions in several authors, and shells in most of the cabinets of the curious. See PURPLE-Fish.

The

The method of obtaining the colour, Mr. Cole (see *PURPLE-Fish*) describes thus :

The shell, which is very hard, being broken, (with the mouth of the fish downwards, so as not to crush the body,) and the broken pieces being picked off, there appears a white vein lying transversely in a little furrow or cleft next the head of the fish.

In this vein is the purple matter lodged ; some of which, being laid on linen, appears at first of a light green colour ; and, if exposed to the sun, soon changes into a deep green, and in a few minutes, into a sea-green, and, in a few more, into a blue ; thence it soon becomes of a purplish-red, and, in an hour more, of a deep purple red.

And here the sun's action terminates ; but by washing in scalding water and soap, and drying it, the colour ripens to a most bright and beautiful crimson, which will bear washing admirably without the addition of any styptic. While the cloth marked with this colour lies in the sun, it will yield a very strong and fetid smell, as if garlic and assa fœtida were mixed together.

The juice which gives this beautiful purple colour is, says M. du Hamel, while it remains in the body of the animal, and while that is in health, wholly white ; but no sooner is it exposed to the sun, than it begins to change colour, and in less than five minutes goes through the several changes of pale green, yellowish, and a beautiful emerald green ; after this it becomes of a deeper and duskier green, then blueish, reddish, and finally a deep and very beautiful purple. Sometimes the juice is found naturally green in the animal : this is probably from the creature's being in a diseased state. But when it is naturally thus, it immediately becomes red, and afterwards purple, on being exposed to the sun ; its several preceding changes seeming to have been made already in the body of the animal.

If a piece of linen be rubbed over with this juice, and part of it exposed to the sun, part not, that only will turn red which is so exposed, the other remaining green without any alteration ; and it is observed, that the stronger the sun shines, the quicker the change appears, and probably the colour is in proportion also the more beautiful and lively. And it is very remarkable, that if a needle, or any other opaque body, be laid upon the linen which is yet green, and is to become red on being exposed to the sun ; after such an exposure, the whole shall be changed red or purple, excepting only that small spot which is covered by the needle, which will still remain green.

A plate of glass, though it be three inches thick, will not prevent the colour from changing purple by being laid over it ; but the thinnest piece of metal will keep it wholly green. The one being opaque, and the other pellucid, are evidently the only reasons for this difference.

If the coloured linen be successively covered by three pieces of paper, the one blacked with ink, the other in its natural state, and the third rubbed over with oil, it will change colour on being exposed to the sun in different degrees ; and that exactly in proportion to the degree of transparency in each of the papers : most of all in that which was covered with the oiled paper ; something less in that covered by the paper in its natural state ; and least of all in that which was covered with the blacked paper, as that is least transparent.

The common heat of a fire, or that of a red-hot iron, produces no change at all in the colour when green. The vapour of burning sulphur produces a little ; but the green, which had not changed to purple by these experiments, immediately changed to it on being exposed to the rays of the sun.

These experiments were all made in the months of January and February, by M. du Hamel, in Provence ; and the sun having power to change the colour so speedily there in these cold months, probably in a warmer climate or season the air would have been sufficient for the purpose, without the open sun ; since it seems, from experiment, that both the solar rays, and the light alone in a cloudy day, can act upon this colour. The light and heat of the sun both act on this colour : light is always sufficient to produce the effect, but the heat may easily be too great or too little ; and to do the whole in perfection, it must be at a certain middle degree.

This beautiful purple, if it can ever be brought into use in dyeing, will have one very great advantage from its viscosity. The pieces of cloth that had been stained by it retained their colour, in spite of several boilings in different liquors, which M. du Hamel made them pass through ; and the colour, on examination, was found not to be superficial, but penetrated the whole body of the stuff, which was tinged by it. There are many inconveniences which must naturally attend the use of this substance as a dye, but they may, perhaps, all be got over by care and application. It is very certain, that it is of too viscid a nature easily to penetrate many substances ; but it is also certain, that this might be obviated by dissolving it in some proper liquor. It appears very plainly, that the ancients had a method of thus dissolving their purple ; but we neither know what was their purple, nor what was its dissolvent ; nor, which would be of much more consequence to us at present, what is the proper dissolvent for our own. *Mem. Acad. Scien. Par. 1736.*

M. Reaumur has also discovered another very different kind of purple. This is produced in oval grains about a quarter of an inch long, full of white liquor bordering on yellow, which cover certain stones or sands, about which the buccina of Poitou usually assemble.

By the experiments M. Reaumur has made, it appears that these grains are neither the eggs of the buccinum, nor the seeds of any sea-plants, nor any rising plants, but the eggs of some other unknown fish.

These grains, being bruised on a white linen, at first only tinge it yellow, and that insensibly ; but in three or four minutes they give it a very beautiful purple red, provided the linen be exposed to the open air ; for the air of a room, even though the windows be open, will not do. This colour fades, however, a little by repeated washings.

M. Reaumur concludes, from some experiments he made, that the effect of the air on the liquor does not consist in its taking away any particles of it, nor in giving it any new ones, but only in its agitating it, and changing the arrangement of the parts that compose it. He adds, that the liquor of the buccinum, and that of the grains, seem to be nearly of the same nature ; except that the latter is more watery, and only saline ; whereas the other is hot, and pungent.

P. Labat gives us the description of another purple dye, produced by a tree growing in the Antilles. The juice of this tree, when cut standing, is of a blood-red, and communicates the same colour to cloths ; though, like the former, it loses much in often washing.

PURPLE, Dyeing. See *DYEING*.

PURPLE Gold. See *GOLD Precipitate*, &c.

PURPLE, in Medicine, an epithet applied to every disease, in which eruptions of purple spots, or *petechiæ*, appear, and these being usually the accompaniments of fevers of every kind in their worst and most dangerous forms, so *purple* fever

fever was nearly synonymous with *putrid*, or *malignant* fever. See PETECHIÆ, and PURPURA.

PURPLE Apple, in *Botany*. See ANNONA.

PURPLE Fish, *Purpura*, in *Natural History*, the name of a genus of shell-fish, the characters of which are these: it is an univalve shell, jagged and beset from head to tail with spines, tubercles, umbos, or striæ. The mouth is small and roundish; the tail is short, and usually the base runs out into a long beak. See DYEING.

It has been usual with most authors to confound together the genera of the murex and purpura, and to use the words as synonymous: but though there is some external resemblance between many of the shells of the two genera, yet they are easily distinguished by this, that the mouth of the purpura is less long, and is less dentated and alated than that of the murex. The body and the head of the shells of this genus are not so elevated as those of the murex kind, and are not covered with points or buttons at the mouth. If a shell is therefore found to have a small, smooth, and round mouth, and a body covered with undulated leaves, as it were, like those of favory or endive, and sometimes with long points, and its tail, whether long or short, be hollowed and somewhat bent, this may be called a purpura, and not a murex. Linnæus makes the purpura a species of the murex.

The ancients distinguished three kinds of purpura; one which had a long and crooked tail, made hollow like a tube or pipe; a second which had either no tail at all, or at the most a very short one; and a third which had no spiral head, or, as we should express it, no clavicle.

On examining the whole family of the purpuræ, we may distinguish four remarkable specific differences among them. The first of these comprehends those purpuræ which have the body of the shell garnished with a sort of undulated foliage in clouded ridges, and have a short and crooked tail. The second comprehends those which have the body of the shell covered with acute points, and have a long tail. The third comprehends those which have as long a tail as the former, but have a smooth body, or at the utmost have only a few slight protuberances and wrinkles on it. And the fourth takes in those which are small, and have an elevated clavicle, a short crooked tail, and the body of which is covered either with slender spines or hairs.

This species of fish, as well as the murex, served among the ancients to dye the fine purple colour they were so fond of, and some of the buccina (*e.g.* the *lapillus* of Linnæus) have been of late found to have the same juice. The purpura and murex are both fished up in great plenty in the gulf of Tarentum; but the small quantity of the coloured juice which each fish contains, and the necessity of using it before the animal dies, makes it impossible to bring it to any regular article of traffic. The ancients used this colour only on cotton and woollen stuffs; whereas our cochineal, which was unknown to the ancients, strikes equally well on silks and stuffs. These shells are also found in various parts of the Mediterranean.

In the seas of the Spanish West Indies about Nicoya, is found a shell-fish, which perfectly resembles the ancient purpura, and, in all probability, is the very same. This fish, Gage tells us, usually lives seven years; it hides itself a little before the dog days, and continues to disappear for three hundred days running.

They are gathered plentifully in the spring, and, by rubbing one against another, they yield a kind of saliva or thick glair, resembling soft wax: but the purple dye is in the throat of the fish, and the finest part is lodged in a little white vein; the rest of the body is of no use. He adds, that the chief

riches of Nicoya consist in this fish. Cloth of Segovia, dyed with it, is sold for twenty crowns the ell; and none but the greatest Spanish lords use it.

There are also found upon the coasts of the South-sea, near the equator, in the neighbourhood of point St. Helena, in the province of Guayaquil, certain sea-snails, as Don Antonio de Ulloa calls them, sticking to the stones, and covered by the sea at high water, about the size of small nuts, which contain a liquor or juice that has the true colour of purple. The colour is very bright, and so durable, that washing rather increases than diminishes its lustre, nor does it fade or decay by use and wearing. Woven stuffs are not dyed with it, but only cotton threads. As soon as a sufficient quantity of the liquor is squeezed from the fish, the cotton thread is drawn through it, and it takes and retains the tincture without any farther trouble; but the purple colour is not discovered till the thread is dry, the juice being of a milky colour at first, but it soon changes into green, and at last settles in a purple.

Besides the Indian purple fishes, we have others much nearer home. In the Philosoph. Transact. abr. vol. ii. p. 823, we have an account of purple fish discovered in 1684, by Mr. W. Cole, on the coasts of Somersetshire, South Wales, &c. where it is found in great abundance. The modern purple fish, M. Reaumur observes, is a kind of buccinum, a name given by the ancients to all fishes whose shell bears any resemblance to a hunting-horn; and it appears from Pliny, that part of the ancient purple was taken from this kind of shell-fish: so that this may be esteemed a recovery of what had been supposed entirely lost. See DYEING.

The fish, he observes, is good; and adds, that there are several kinds of it differing in size and shell, and also in the colour of the tinging liquor. There are some found on the coasts of Poictou.

The Caribbee islands have likewise their purple fish. This is called *burgan*, being of the size of the end of the finger, and resembling our periwinkles; its shell is of a brownish azure, its flesh white, its intestines of a very bright red, the colour of which appears through the body; and it is this that dyes the froth, which it casts forth when taken, and which is at first of a violet hue, bordering on blue.

To oblige them to yield the greater quantity of froth, they lay them on a plate, and shake and beat them against one another; upon which the plate is immediately covered with the froth, which is received on a linen cloth, and becomes purple in proportion as it dries.

P. Labat observes, that if this be the real Tyrian purple, the secret of preparing and fixing it is lost; this colour being found to dwindle and dissipate, in proportion as the linen dyed with it is washed.

The purpura lives on other fish. It usually hides itself at a small depth in the sand, sometimes even in fresh-water rivers, and as it lies hid, it thrusts up a pointed tongue, which wounds and kills any thing that comes over it. We frequently find sea-shells with round holes bored through them, as regularly as if made with a boring instrument: these are generally allowed to be made by the tongue of the purpura, in order to its feeding on the fish within.

The purpura has two horns like that of a snail; and Fabius Columna says, that they have eyes in these, not placed at the ends, as in the snail, but in the middle of each horn.

The purpura is a shell-fish very well known, and has been known also in almost all times to afford a purple liquor; but as there has been no method discovered of bringing this li-

quor into use in dyeing, the fish has been neglected, and its juice never attempted to be brought into use.

PURPLE-Wort, in *Botany*, a name given to several species of trefoil.

PURPRESTURE, in our *Ancient Law Books*. See **POURPRESTURE**.

PURPRISUM, of the French *pourpris*, denotes a close, or inclosure: also the whole compass or extent of a manor or place.

"Donavi eis in eum purprifum de Kirkeham, & domos meas, & molendinum, & prata, &c." Charta Walteri Espec. Priorat de Kirkeham.

PURPURA, **PERSIAN**, the same with the Persian shell, a species of dolium.

PURPURA, in *Medicine*, in the nomenclature of cutaneous diseases proposed by Dr. Willan, signifies an eruption of purple specks and patches, that is of *petechiæ*, *ecchymomata*, and *vibices*, accompanied with general debility, but not always with fever.

Under this limitation, the purpura is synonymous with the "petechiæ sine febre" of some medical writers, (see Rombergius, Ephem. Natur. Curios. dec. iii. ann. 9 and 10, obi. 108; and Dr. Graaf, Diss. Inaug. de Petechiis sine Febre, Gött. 1775); with the "hæmorrhæa petechialis" (see Dr. Adair, Diss. Inaug. Edin. 1789, and Dr. Bateman, Diss. Inaug. ibid. 1801); with the "land-scurvy," &c. of others. Riverius, Diemerbroeck, Sauvages, Cullen, and one or two others, appropriated the term *purpura* in like manner to *petechial* spots only, and rightly excluded from this appellation all other eruptions of a character essentially different.

In thus limiting the acceptance of the term, however, it is proper to mention, that in the writings of many physicians it is applied to various other eruptive diseases, which have no affinity with petechial blotches, and very little with each other. Thus, under the name of purpura, the red-gum, or strophulus, is described by Etmüller,—the scarlet fever by Schultz and Juncker,—the measles by Hafenreffer and Morton,—the nettle-rash, miliary vesicles, and lichen, by Hoffmann and others. See Willan on Cutan. Dis. p. 452.

The purpura occurs under various degrees of violence, which induced Dr. Willan to make two species, which he denominated *simplex* and *hæmorrhagica*, according as the eruption occurred alone, or with discharges of blood. It is impossible, however, to draw so distinct a line, where nature presents no clear difference. We can only state that, in the milder degrees, there is an eruption of petechiæ only, chiefly appearing on the extremities and breast, and seldom affecting the face. The complexion is generally pallid or fallow, and there is a considerable degree of debility and languor, and sometimes pains in the limbs.

In the more severe cases of the disease, the failure of strength is considerably greater, and often precedes, for some time, the appearance of the eruption. The spots commonly appear first on the legs, where they are usually the largest and most numerous, and are often accompanied with anasarcaous swellings. When they first appear, they are of a bright red hue, but they gradually become purple or livid, and when about to disappear, they change to a brown or yellowish hue; so that in the progress of the disease, as the spots appear and fade in succession, the skin presents a considerably variegated appearance. In the more severe forms, the petechiæ are intermixed with *ecchymoses* and *vibices*, or livid patches and stripes, resembling the effects of a bruise, or of the strokes of a whip. In this state, sometimes, when these patches do not appear spontaneously,

the gentlest pressure on the skin, such as is applied in feeling the pulse, will produce a purple blotch, like that which follows a severe blow.

When the disease is still more severe, in addition to these effusions of blood under the cuticle, considerable discharges of blood take place from those parts which are defended by a very delicate cuticle; whence these hæmorrhages originate particularly from the internal passages and organs, and are occasionally very profuse, endangering, and occasionally destroying life. Most frequently, however, the bleeding is slow, and in small quantity, sometimes almost a constant oozing, and sometimes returning at intervals. These hæmorrhages take place from the gums, nostrils, throat, the inside of the cheeks, the tongue, and lips; sometimes from the lining membrane of the eye-lids, the urethra, and the external ear; and often from the internal cavities, the lungs, stomach, bowels, kidneys, uterus, and bladder. There is great variety, however, in the periods of the disease at which the hæmorrhages commence and cease, and as to the proportion which they bear to the cutaneous effluence.

This singular disease occasionally appears suddenly, in the midst of good health, attacking during the night. It is always accompanied by great feebleness and depression of spirits; and often by pains in the chest, loins, or abdomen, by irregularity of bowels, or by cough; and the pulse is sometimes slightly quickened and very feeble, as in a moderate hectic. But in some cases these functions are not perceptibly disturbed. The duration of the disease is equally uncertain: in some instances it has terminated in a few days, while in others it has continued not only many months, but years. When it terminates fatally, it is commonly in consequence of a copious hæmorrhage, either suddenly from some important organ, or more slowly from several parts at the same time.

The causes of this disease are not clearly ascertained, nor its pathology well understood. It occurs at every period of life, and in both sexes; but most frequently in women, and in boys before the age of puberty, particularly in those who are of a delicate habit, who live in close and crowded situations, and on poor diet, or are employed in sedentary occupations, and subject to grief, anxiety, fatigue, and want of sleep. It has likewise attacked those who are left in a state of debility by previous acute and chronic diseases, as after measles or small-pox, or during confinement in the puerperal state, or after a violent salivation from mercury. On the other hand, however, the disease appears occasionally in its most severe and fatal form, where none of these circumstances had previously existed: for instance, in young persons living in the country, and suffering no privation of any of the comforts of life, and previously enjoying good health. This fact tends greatly to obscure the pathology of the disease: for it renders the operation of these alleged causes extremely questionable, and seems to establish an essential difference between purpura and scurvy, in the origin and nature of the morbid actions which constitute the disease. In scurvy (by which we mean the *scorbutus*, or true scurvy, formerly prevalent among seamen in long voyages, and among people in besieged towns, and other situations, when living upon putrid, salted, dried, or otherwise indigestible food, yielding imperfect nutriment,) the restoration of the proper nourishment, with the use of fresh vegetables and acids, invariably removes the symptoms, and they never commence where such diet can be obtained: while, in many cases of purpura, this diet has been taken abundantly, without the smallest alleviation of the complaint, and the disease has come on, where there had been no deficiency. "On the other hand, the rapidity of the

the attack, the acuteness of the pains in the internal cavities, the actual inflammatory symptoms that sometimes supervene, the occasional removal of the disease by spontaneous hæmorrhage, the frequent relief derived from artificial discharges of blood, (see two cases of purpura by Dr. Parry, Edin. Med. and Surg. Journ. for Jan. 1809), and from purging, all tend to excite a suspicion that some local visceral congestion or obstruction is the cause of the symptoms in different instances." (Bateman's Practical Synops. of Cutan. Dis. p. 110.) Several facts in proof of these observations are stated in the work just quoted; but a sufficient number has not yet been collected to afford any general inference respecting the nature of the disease.

The cure of purpura is, therefore, not established upon any clear principle, and there has been considerable difference of opinion upon the subject. Dr. Willan has given a very imperfect view of this point. All that he says relative to the cure of the worst form of purpura, is comprised in these few lines. "In the treatment of this disease, we should recommend moderate exercise in the open air, a generous diet, and the free use of wine, Peruvian bark, vitriolic acid, &c. Without air, exercise, and an easy state of mind, the effect of medicines is very uncertain." (On Cutan. Diseases, p. 461.) Of this, indeed, he has given an ample proof in the next sentence, where he tells us that a patient "took for two or three months Peruvian bark in considerable quantities, the vitriolic and marine acid, and wine, without much advantage." In truth, the cure of purpura is, we believe, not to be effected by these means. In the slighter degrees of the disease, occurring in children who are ill fed and nursed, and excluded from the air and from all exercise, these tonics may seem to do good, when combined with air and exercise. "But," as Dr. Bateman observes, "when it occurs in adults, especially in those already enjoying the benefits of exercise in the air of the country, and who have suffered no privation in respect to diet; or when it appears in persons previously stout, or even plethoric; when it is accompanied with a white and loaded tongue, a quick and somewhat sharp, though small, pulse, occasional chills and heats, and other symptoms of feverishness, however moderate;—symptoms which may be presumed to indicate the existence of some local congestion;—then the administration of tonic medicines, particularly of wine, cinchona, and other warmer tonics, will be found inefficacious, if not decidedly injurious. In such cases, free and repeated evacuations of the bowels, by medicines containing some portion of the muriate of mercury, will be found most beneficial. The continuance or repetition of these evacuants must, of course, be regulated by their effects on the symptoms of the complaint, or on the general constitution, and by the appearance of the excretions from the intestines. If the pains are severe and fixed, and if the marks of febrile irritation are considerable, and the spontaneous hæmorrhage not profuse, local or general blood-letting may doubtless be employed with great benefit, especially in robust adults." Pract. Synopsis, before quoted, p. 114.

The importance of free purgation in purpura has been clearly stated in a short but valuable communication from Dr. Harty, of Dublin, published in the Edinburgh Medical and Surgical Journal, for April, 1813: in more than a dozen cases treated in this manner by Dr. Harty, the hæmorrhages ceased, and the purple spots disappeared, after a few doses of calomel and jalap had been taken. In the two cases related in the same useful journal by Dr. Parry, of Bath, before alluded to, and which were speedily cured by two bleedings from the arm, the blood drawn exhibited

a tenacious contracted coagulum, covered with a thick coat of lymph, as in diseases of an inflammatory nature. The patients were a lady and an officer, the latter of whom was accustomed to free living; in both cases some degree of feverishness accompanied the purpura.

There is one variety of the disease, which Dr. Willan distinguished as a third species, by the title of purpura urticans, because the eruption commences in the form of rounded and reddish elevations of the cuticle, resembling the wheals of nettle-rash; but they are not accompanied by the same sensations, tingling and itching, which belong to the nettle-rash. These little tumours gradually dilate; but within one or two days they subside to the level of the surrounding cuticle, and at the same time their hue becomes darker and at length livid, or purple. As these spots are not permanent, but appear in succession in different places, they are commonly seen of different hues; the fresh and elevated ones being of a brighter red, while the level spots exhibit different degrees of lividity, and become brown as they disappear. They are most common on the legs, where they are frequently mixed with petechiæ; but they sometimes appear on other parts of the body.

The duration of the purpura urticans is various, from three to five weeks, in the course of which time the hands and ankles are affected with œdematous swellings: there is also a distressing degree of languor and debility, and a loss of appetite, but seldom hæmorrhage. It generally appears in summer and autumn, affecting those who are exposed to fatigue, and live on poor diet, and delicate young women of indolent and luxurious habits. The same precepts, as to treatment, are applicable to this as to the other varieties of purpura.

When purple spots occur as symptomatic of bad fevers, they require no peculiar treatment. They are much less frequent concomitants of fevers than they were formerly; a circumstance which is probably to be ascribed partly to the more liberal use of purgatives at present in all febrile diseases, and partly to the more free admission of fresh air, to the superior cleanliness, &c. now observed in these maladies. The appearance of these spots has been occasionally noticed by various authors in agues, remittent fevers, palsies, dropsy, and atrophy. Dr. Willan observes, that in the last stage of pulmonary consumption they sometimes occur as the immediate forerunners of death. (See PETECHIÆ.) For histories and cases of purpura, see Duncan's Med. Comment. vols. xiv. and xx. and Med. Cases and Observ. p. 90. Annals of Medicine, vol. ii. Memoirs of the Med. Society of London, vol. iii. art. 20; and vol. iv. art. 17. Medical Tracts and Obs. vol. ii. Willan's Reports on the Diseases of London.

PURPURATI, in our *Ancient Historians*, denote the sons of emperors and kings.

PURPURE, POURPRE, or Purple, in *Heraldry*, according to some, is one of the five colours of armories, mixed or compounded of gules and azure, bordering on violet; and, according to others, of a little black and much red colour. It is, by the heralds, supposed a symbol of temperance, liberality, dignity, authority, faith, and piety. Most authors in heraldry, as Favyn, Geliot, Monet, and Menestrier, do not allow purple for a colour, in regard it is not simple, but composed of a mixture of other colours. They rather esteem it a kind of intermediate tincture, sometimes metal, and sometimes colour: hence the Spaniards call it *una mision*: so that one cannot lay it on metal and colour without falsifying the arms.

Add, that many take the purple, as it is accounted, many ancient bearings, by which some of the moderns would

evince the regularity and legitimacy of this colour in armory, to be no other than silver tarnished.

Spelman, however, in his *Aspilogia*, allows purple the preference before all other colours, as having been an enlign of royalty for many ages; yet even he allows it to have been excluded, by the ancient heralds, as only an imperfect colour.

It is represented in engraving, by diagonal lines drawn from the sinister chief to the dexter base point. In the coats of noblemen it is called *amethyst*; and in those of princes, *Mercury*.

PURPURINA, a name used by Caneparius, and some other authors, for the aurum mosaicum, or aurum musivum of the shops, the present preparation of which differs from that of that author only in the proportions of the ingredients.

PURPURISSUS, in the *Ancient Writers*, both Greek and Roman, the name of a compound colour or fucus of a fine purplish red, used to paint women's cheeks.

It seems by the composition to have been somewhat like our rose pink, as it is called by the colourmen. It was made of the creta argentaria, or fine white kind of chalk, dissolved in a strong purple tincture of some of the roots of wood which dyed red; and when the coarser part was subsided to the bottom of the vessel, the liquor, while yet thick, was poured off into another vessel; and what subsided from this, which was as fine as flour, was of a beautiful pale purple, and was the purpurissus saved for use.

PURREL, anno 35 Eliz. cap. 10. a list ordained to be made at the ends of kerseys, to prevent deceit in diminishing their length.

PURRONGUR, in *Geography*, a town of Hindoostan, in the circar of Bilfa; 20 miles S.E. of Bilfa.

PURROWNAH, a town of Hindoostan, in Oude; 28 miles E. of Gooracpour. N. lat. 26° 57'. E. long. 84° 17'.

PURRUAH, a small circar of Bengal, about 16 miles in circumference; N. of Mauldah.—Also, a town of Bengal, and chief town of the said circar; 26 miles E.S.E. of Burdwan. N. lat. 23° 4'. E. long. 88° 25'.

PURSAH, a town of Hindoostan, in Bahar; 18 miles N.W. of Chuprah.

PURSAUMMAH, a town of Hindoostan, in Bahar; 35 miles E. of Durbungah.

PURSE, a manner of accounting; or, as some call it, a species of money of account, much used in the Levant, particularly at Constantinople, where it is 500 aspers; three aspers being equal to a para, and forty paras equal to a piastre, called by the Turks grouch, and by the English dollar. By the regulations of 1780, the purse of 500 pialtres was to weigh 2812½ Turkish drams. A single piastre weighed 5½ drams, or 277 English grains; and the other pieces in proportion. Their standard of fineness was reduced at the same time to 50 carats (or hundredth parts) of fine silver, and 50 of alloy: which gave the value of the piastre at 19¼d. sterling, and the other silver coins in proportion. But since that period the Turkish coins have undergone a deterioration, so that a piastre of the latest coinage being weighed and assayed by the king's assay master of the Mint, appeared to be in weight 8 dwt. 6 gr.; in fineness, 5 oz. 6 dwt. worse than the English standard. This gives its fineness 47 carats 2 grains Turkish, and its value, in sterling, 13¼d. Kelly's Un. Cambist.

This money of account is called purse, because all the grand signior's treasure in the seraglio is kept in leather bags of this value.

In this, however, there is some difference; for the purse

in Egypt is 25,000 medinis, or 75,000 aspers; and in other parts of Turkey it is only 20,000.

This method of accounting the Turks derive from the Greeks, and they from the Romans; the emperors of which brought it to Constantinople, as appears from a letter of Constantine to Cecilian, bishop of Carthage, quoted by Eusebius and Nicephorus. See FOLLIS.

PURSE-Net, in *Rural Economy*, a net used for taking both hares and rabbits at certain times; and three or four dozen of them are sufficient to lay over their holes: they are to be fastened, by tying strings to sticks thrust into the earth, otherwise when the rabbits bolt out, they will run away and get out of the nets; but when the nets are fixed, and all things are in order, there must be one or two persons to lie close, to see what game comes home; while, in the mean time, you beat the bushes, to force them homewards. But another way to take rabbits with these nets is, at their coming out of their parraces: and they should be secreted in this manner. First hunt them up and down, to force them all in, then put in a ferret, with a bell about her neck, which gives the rabbit notice of her coming, who, in endeavouring to avoid the ferret, runs into the net.

PURSER, an officer aboard a man of war, appointed by the lords of the admiralty, who receives her victuals from the victualler; and is to take care that it be in good condition, and well laid up and stowed. He is also to see that they are carefully distributed to the officers and crew, according to the instructions which he has received from the commissioners of the navy for that purpose. To him also belongs the distribution of slops, &c.

He is also to keep a list of the men and boys belonging to the ship, and to set down, exactly, the day of each man's admittance into pay; that the paymaster or treasurer of the navy may issue out his disbursements, and pay off the men according to the muster-book.

PURSIVENESS, or PURSINESS, among *Farriers*, thickens of wind, a name common to all those diseases in horses which arise from obstructions in the passages of the lungs.

Pursiveness, sometimes also called *broken wind*, may proceed from an ulcer, or some inward walling of the lungs, in which the small vessels are worn or abraded by the sharpness or acrimony of the common discharges.

The like disorder may also arise from a stagnation, hindering the air from penetrating so as to lift up the lungs in the act of respiration; or from some tough and mucilaginous matter separated in the branches of the wind-pipe.

The usual occasions are cold, surfeits, and other diseases not thoroughly carried off. Purfive disorders may also arise from unwholesome food, bad air, and hard riding when a horse is full. The signs are commonly a heaving and beating of the flanks; a wheezing and rattling. Sometimes the kernels about the throat will swell, and there will be a glandulous running at the nose, which is the utmost stage of the disease, and usually reputed desperate.

PURSLANE, in *Botany*. See PORTULACA.

PURSLANE, *Horse*. See TRIANTHEMA.

PURSLANE, *Sea*. See ATRIPLEX.

PURSLANE *Tree*. See PORTULACARIA.

PURSLANE, *Water*. See PEPLIS.

PURSOTTUMPOUR, in *Geography*, a town of Hindoostan, in Bahar; 35 miles W.S.W. of Arrah.

PURSOYAH, a town of Hindoostan, in Bahar; 25 miles W.S.W. of Gayah.

PURSUIVANT. See POURSUIVANT.

PURSUR, in *Geography*, a town of Hindoostan, in Oude; 13 miles N. of Mahomdy.

PURVER, ANTHONY, in *Biography*, was born at Up-Hurstborn,

Hursborn, in Hampshire, about the beginning of the 18th century. His education was extremely limited, but he exhibited a striking proof of his capacity for learning while he was very young; for, being prevented by illness from attending school almost six weeks, he applied, by himself, during that time, with such diligence and success to the study of arithmetic, that upon his return to school he was able to explain the processes of evolution to his master, whose attainments had not carried him so far. At this time of life he exhibited great powers of memory, by committing to it twelve of the longest chapters in the bible in as many hours. He was put apprentice to a shoe-maker, who was also a dealer in sheep, and employed Anthony a good deal in looking after his flock. This was not by any means an irksome business, as it afforded him an opportunity for reading the scriptures, to which he was particularly attached. As he advanced in years, he found that his favourite book contained doctrines that were very differently interpreted by different persons, and he was resolved to study the Old and New Testament in their original languages. Having renounced the occupation for which he was originally intended when he was about twenty years of age, he commenced teacher in a school, but afterwards removed to London, for the sake of more easily acquiring the means of prosecuting his studies. Here he probably resided in 1727, when he published his work, entitled "The Youth's Delight." While at London he became a Quaker, and officiated among the friends in the character of a minister. He returned to Hursborn, and resumed his school in 1727, and probably continued it for some time, during which he began to translate the books of the Old Testament, from the original Hebrew. While thus employed, he felt it his duty to become a missionary, and travelled through several counties of the kingdom, till he came to Stambrook, near Bristol, towards the latter part of the year 1738. Here he resided at the house of a maltster, whose son he instructed in classical learning, while he devoted his leisure to his favourite employment of translating the scriptures. In 1746 he made an attempt to publish his translation of the Old Testament in numbers; but for want of encouragement he did not proceed beyond two or three numbers. When he had completed the translation of the whole bible, he could find no bookseller who would embark in the publication. Thus was the labour of thirty years likely to be lost, till Dr. Fothergill made him a present of 1000*l.* for the copy, and took upon himself the expence of printing the work. Under his auspices, it made its appearance in the year 1764, with the title of "A new and literal Translation of all the Books of the Old and New Testament, with Notes critical and explanatory," in 2 vols. folio. It was the author's intention to have published a second edition, with various corrections and alterations, but he did not live to accomplish the design. He died in 1777, about the age of 75. Purver was described by Dr. Fothergill as "a man of great simplicity of manners, regular conduct, and a modest reserve: he is steadily attentive to truth, hates falsehood, and has an unconquerable aversion to vice; and to crown the portrait, he is not only greatly benevolent to mankind, but has a lively sense of the divine attributes, and a profound reverence of, and submission to, the Supreme Being." *Gent. Mag.*

PURVEYANCE. See POURVEYANCE.

PURVEYOR. See POURVEYOR.

PURVIEW, from the French, *pourveu*, a gift, grant, provision, &c. a term frequently used, by sir Edward Coke,

for the body of an act of parliament, or that part which begins with *Be it enacted*, &c. as contradistinguished from the *preamble*.

The statute of 3 Hen. VII. stands upon a preamble and a purview. 12 Rep.

PURULENT, PURULENTUS, in *Medicine*, something mixed with, or partaking of, pus or matter.

Phthical people frequently spit a purulent matter. In a dysentery, the stools are purulent: when there is an ulcer in the reins or bladder, the urine is purulent.

PURUSHA, in *Mythology*. See PARUSHA.

PURUZ, in *Geography*, a river of La Plata, which rises about S. lat. 17° 20', taking the name of "Rio Beni," and afterwards called "Amaru-Mayu," or "The Serpent;" from S. lat. 12° its course is not ascertained till it comes to S. lat. 6°, after which it assumes the name of Puruz, and runs into the river of the Amazons, or Marañon, S. lat. 3° 44'. W. long. 45° 6'. Its whole course is northerly about 800 miles.

PURWAR, a town of Hindoostan, in Lahore; 14 miles S. of Sealcot.

PURYSBURG, a handsome town of South Carolina, in Beaufort district, which district contains 25,887 inhabitants, on the E. side of Savannah river, 37 miles from the ocean, and 20 from Savannah. It derives its name from a Swiss, John Peter Pury, who settled a colony of his countrymen here about the year 1735, with a view to the culture of silk. The mulberry-trees are still standing, and some attention is paid to the raising of silk. The town contains between 40 and 50 dwelling-houses, and an episcopal church; 64 miles W.S.W. of Charlestown. N. lat. 32° 23'. W. long. 81° 12'.

PUS, from *πύω*, matter, the fluid contained in abscesses, and discharged from ulcerated surfaces, and sometimes from membranous surfaces which are merely inflamed, and quite free from ulceration, as is illustrated in cases of gonorrhea, empyema, &c. Pus is formed by a peculiar process, which is termed *suppuration*, of which we shall have occasion to speak in a future volume of this work.

In the present place, we shall content ourselves with inserting a few observations on the qualities and uses of pus, chiefly taken from the writings of Mr. Hunter.

True pus has certain properties, which, when taken singly, may belong to other secretions, but which, conjointly, form the peculiar character of this fluid, viz. globules swimming in a fluid, which is coagulable by a solution of sal ammoniac, which no other animal secretion is, and, at the same time, a consequence of inflammation.

The colour and the consistence of pus are the two qualities which first attract the notice of every, the most superficial, observer. The colour arises from the largest portion of this fluid being composed of very small round bodies, very much like those little globules which, swimming in a fluid, make cream. The fluid in which the globules of pus swim, we might at first suppose to be the serum of the blood, for it coagulates with heat, like the latter fluid. Pus is also probably mixed with a small quantity of coagulating lymph; as it partly coagulates after it is secreted.

The fluid part of pus, however, is known to have properties which serum has not. There being a similarity between pus and milk, experiments have been made to ascertain whether the fluid of pus could be coagulated with the gastric juice of animals; but no coagulation could be effected in this manner: a solution of sal ammoniac made the fluid part of pus coagulate; but not any other secretion,

or

or natural fluid; and hence it was concluded, that whenever globules were found swimming in a fluid, coagulable by sal ammoniac, the matter was to be considered as pus.

The proportion which the white globules bear to the other parts of pus, depends on the health of the parts producing the discharge. When the globules are very abundant, the matter is thicker and whiter, and is called healthy pus; the meaning of which is, that the solids, which produced it, are in good health; for these appearances in the matter are no more than the result of certain salutary processes going on in the solids, the effect of which processes is to produce the disposition, on which both suppuration and granulation depend.

Pus is specifically heavier than water, and is probably about as heavy as blood.

Besides the above properties, pus has a sweetish mawkish taste, very different from that of most other secretions, and the same taste takes place, whether it is pus from a sore, or an irritated inflamed surface.

Pus has a smell in some degree peculiar to itself; but this differs in different cases. Some diseases, it is said, may be known by the smell, as, for instance, a gonorrhœa.

Pus sinks in water; mucus floats. Pus communicates to water an uniformly troubled white colour; mucus gives the appearance of stringy portions floating in it. Mucus is said to be more readily dissolved by sulphuric acid than pus is. It has also been asserted, that if water be added to such solutions, the pus is precipitated to the bottom of the vessel; while the mucus, instead of being completely precipitated, forms swimming flakes. A solution of caustic alkali dissolves both pus and mucus; but when water is added, the pus is said to become separated, but not the mucus.

Though solutions in chemical menstrua and precipitations have been thought a test of the distinction between these two fluids; yet the method has been thought absurd and unphilosophical. It has been conceived, that all animal substances whatever, when in solution, either in acids or alkalies, would be in the same state, and therefore, that the precipitation would be the same in all. Calcareous earth, when dissolved in muriatic acid, is in that acid in the same state, whether it has been dissolved from chalk, limestone, marble, or calcareous spar, and precipitations from all are the same. Hence experiments were made on organic animal matter, such as muscle, tendon, cartilage, liver, and brain; and on inorganic, such as pus and the white of an egg. All these substances were dissolved in sulphuric acid, and precipitated with the vegetable alkali. Each precipitation was examined with such magnifiers as plainly shewed the forms of the precipitates, all which appeared to be flaky substances. The precipitate by the volatile alkali had exactly the same appearance. The same appearances were seen when the above kinds of animal matter were dissolved in the vegetable caustic alkali, and precipitated with the muriatic acid. A flaky substance, void of any regular form, composed each precipitate.

Pus does not irritate the particular surface which secretes it, though it may be irritating to any other. Hence no suppurating surface, of any specific kind, can be kept up by its own matter. If this had not been the case, no sore of a specific quality, or producing matter of an irritating kind, could ever have been healed. This is similar to every other secretion of stimulating fluids, as the bile, tears, &c. which fluids do not stimulate their own glands or ducts, but are capable of stimulating any other part of the body.

Whenever a real disease attacks either the suppurating surface or the constitution, the production of true pus ceases, and the fluid becomes changed in some measure, in proportion to these morbid alterations. In general it becomes thinner and more transparent, and it partakes more of the nature of the blood, as is the case in most other secretions under similar circumstances. *Sanies* is the term usually applied by surgeons to pus in this degenerated state. This unhealthy sort of matter has more of the serum, and frequently more of the coagulating lymph in it, and less of the combination, which renders it coagulable by a solution of sal ammoniac. It has also a greater proportion of the extraneous parts of the blood, which are soluble in water, such as salts; and it has a greater tendency than true pus to become putrid. Such unhealthy matter may even be irritating to the surface which produces it.

The discharge, when of an irritating sort, is more stimulating to the adjoining parts with which it comes in contact, than to its own secreting surface. In this manner it frequently produces excoriation of the skin and ulceration. Thus the tears excoriate the skin of the cheek, in consequence of the quantity of salts which they contain. From this effect, matter has been called corrosive, a quality which it has not; the only property which it possesses being that of irritating the parts which it touches, so as to cause their absorption.

When the vessels thus lose the power of producing good pus, they also lose more or less the power of forming granulations. This may depend on some deviation from the due structure and action which such vessels should possess, in order to be qualified for the performance of these two operations.

Pus, from several circumstances, would appear in general to have a greater tendency to putrefaction than the natural juices have; but, perhaps, this is not the case with pure pus, which, when first discharged from an abscess, is commonly perfectly sweet. There are, however, some exceptions to this, but these depend on circumstances entirely foreign to the nature of pus itself. Thus, if the abscess had any communication with the air, while the matter was confined in it; or if the collection has been so near the colon, or rectum, as to have been infected by the feces, then we cannot wonder that the matter should become putrid. When blood is blended with pus; when sloughs are mixed with it; when the parts forming the seat of the abscess are in a gangrenous state from an erysipetulous affection; the matter has a greater tendency to putrify than the pure pus discharged from sound abscesses, or healing sores. Pure matter, though easily rendered susceptible of change by extraneous additions, is in its own nature tolerably uniform and immutable. It appears so unchangeable, that we find it retained in an abscess for weeks, without having undergone any alteration. These qualities, however, only belong to perfect pus.

In the preceding paragraph it is stated, that matter remains very often unchanged in abscesses for weeks. This expression of Hunter's is not strictly correct; for it is well known, that the surfaces of the cavities of abscesses are always absorbing, as well as secreting ones; consequently there must be a continual mutation going on in the contained matter.

When there are diseased bones, or other extraneous bodies, exciting irritation, sometimes even to so great a degree as to make the vessels bleed, and often wounding the vessels of the part, the matter is always found to be very offensive. This state of the discharge is one mark of a diseased bone.

The discharge of an unhealthy fore blackens silver probes, and preparations of lead. This effect is imputed by Dr. Crawford to the sulphurated hydrogen gas generated in the matter. Phil. Transf. vol. lxxx. for the year 1790. p. 391, &c.

Use of Pus.—By some it is supposed to carry off humours from the constitution. Suppuration is sometimes regarded as a constitutional disease, changed into a local one, which constitutional malady is discharged, or thrown out of the body, either in the form of pus, or together with this fluid. Critical abscesses have been thought to be cases of this sort. Suppuration has also been imagined to carry off local complaints from other parts of the body, on the old principle of derivation or revulsion. For this reason, fores or issues are made in sound parts before allowing other sores to be dried up. Suppuration is sometimes excited with a view of making parts, such as indurated swellings, dissolve into pus; but we have endeavoured to shew that no dissolution of the solids is concerned in the production of pus.

A secretion of pus is looked upon as a general prevention of many, or of all, the causes of disease. Hence issues are made to keep off both universal as well as local diseases. However, the use of pus is perhaps unknown; for it is formed most perfectly from healthy sores, and in healthy constitutions; and large discharges from parts not very essential to life, produce very little change in the constitution, and as little upon being healed up, whatever some may suppose to the contrary.

This is certainly the case with many old ulcers, the suppuration from which seems to have little or no effect in impairing the health. Nor is there any real reason to be afraid of healing such ulcers, when possible, lest a worse disease follow from the stoppage of the discharge, to which the system is supposed to be habituated so much, that the continuance of such discharge is essential to health.

Every one knows, that when there is no interference of art, that is, when the surface of a sore is left uncovered, the thin part of the matter evaporates, and the thick part dries and forms a scab. Nature, therefore, seems to have designed, that one use of pus should be to make a cover and protection for ulcerated surfaces.

Among the secondary uses of suppuration may be mentioned, opening a communication between a disease and the external surface of the body; forming a passage for the exit of extraneous bodies, &c.

PUSA, in *Geography*, a town of Hindoostan, in Bahar; 20 miles E. of Hajypour.

PUSBACH, a town of Germany, in the principality of Culmbach; 12 miles S. of Culmbach.

PUSCHENGA, a river of Russia, which rises in lake Irtys, in the government of Archangel, and runs into the Arctoga near Kevrol.

PUSCHIAVO, a town of Switzerland, in the Grisons, from which is derived the name of one of the jurisdictions held by the duke of Milan, in the year 1436. The greater number of the inhabitants consists of Roman Catholics. The town lies three miles N. of a lake of the same name, abounding in fish, and distant 14 miles S.W. of Bormio, and is situated 17 miles W.S.W. of the same town, and 20 miles E. of Chiavenna.

PUSCHIMA, a town of Russia, in the government of Vologod; 40 miles N.N.E. of Bielozersk.

PUSHAN, in *Mythology*, a name for Surya, a personification of the sun, among the Hindoos, and a name also for their god Siva.

PUSHENG, in *Geography*. See KOOSHINJEE.

PUSHERS, a name given to Canary birds when new flown. See BRANCHER, and CANARY bird.

PUSHING, in *Geography*, a considerable town of Persia, in the province of Khorasan, a little to the N. of Herat, built on the banks of the Herirood, and celebrated for the beauty of the cypress trees which grow in its vicinity.

PUSHPADANVA, in *Mythology*, one of the names of the Hindoo deity Kama, the cupid of their mythology. It means with a flowery bow; his bow, which is made of a sugar cane, having its string composed of flowers and bees. See KAMA.

PUSHPAKA, the name of a flowery car, in which the Hindoo Plutus, named Kuvera, is conveyed. See KURVERA.

PUSILLATUM, a word used by some medical writers to express a coarse powder, or any medicinal substance, beat into small pieces for infusion, or the like purposes.

PUSTING, in *Geography*, a town of Hungary, on the Waag; eight miles N.N.W. of Leopoldstadt.

PUSTOMERZ, a town of Moravia, in the circle of Brunn; 16 miles E.N.E. of Brunn.

PUSTOZIRSK, a town of Russia, in the government of Archangel, near the Petchora. N. lat. 67° 15'. E. long. 51° 14'.

PUSTULE, **PUSTULA**, in *Medicine*, a small elevation of the cuticle, upon an inflamed base, containing pus.

Pustules originate from an inflammation of the skin, and the consequent partial effusion of purulent matter under the cuticle, by which the latter is elevated into small circumscribed tumours. Pustules are of various sizes, sometimes very minute, and sometimes extending to half an inch in diameter; and they terminate either in small ulcerations, or more commonly in scabby crusts. Dr. Willan constituted an order of cutaneous diseases under the head of *pustules*, including five genera, impetigo, porrigo, ecthyma, variola, and scabies; but he never completed this part of his work, a brief compendium of which has been drawn up by Dr. Bateman. (See his Practical Synopsis of Cutaneous Diseases, 1813.) See also IMPETIGO, PORRIGO, SMALL-POX, and ITCH.

By many writers the use of the word *pustule* is very general, including not only purulent elevations of the skin, but vesicles and even pimples; and it must be admitted that the best ancient authority sanctions even a more extensive acceptation of the word, including even wheals, “quæ ex urticâ vel sudore nascuntur.” (Celsus, lib. v. cap. 28.) But not only the etymology (quasi *pus tulit*), but accuracy of language would lead us to limit the term to purulent eruptions, as in the above definition, and as some correct writers have done. See Prof. Arnemann, Comment. de Aphthis. Linnaeus, Gen. Morbor. class. xi. ord. 4, &c.

PUSTVOLA, in *Geography*, a river of Asiatic Turkey, which runs into the sea of Marmora; 16 miles W. of Artaki, in the province of Natolia.

PUSU, in *Botany*, the name of a famous plant growing in China, and greatly esteemed there. This and the ginseng these people a long time kept to themselves; but at length it was discovered, that the one was esteemed a certain prolonger of life, and the other a preservative against all diseases.

They, in their manner of speaking, say, that the pusu gives immortality. We have not been so happy to obtain any of this famous plant for the trial, but the ginseng having been brought over, and found not to possess those great virtues they ascribe to it, and the people in China, who are possessed of the pusu, dying, as well as those who have it not, we find, that the virtues of both are so greatly exaggerated

exaggerated by the eastern dialect, that there is not much to be expected from them.

PUSULA, in *Geography*, a town of Sweden, in the province of Nyland; 37 miles N.N.W. of Helsingfors.

PUT, in the *Manege*, called in French *mettre*, is used for the breaking or managing of a horse: thus,

To put a horse to corvets, or caprioles, is to teach him those parts of the manege.

To put a horse upon his haunches, called in French *asseoir*, is to make him bend them handsomely in galloping in the manege, or upon a stop. See HAUNCHES.

To put a horse to the walk, trot, or gallop, is to make him walk, trot, or gallop.

To put a horse under the button, see BUTTON.

PUTAGE, PUTAGIUM, in our old *Law Books*, denotes whoredom or fornication on the part of a woman.

The word is formed from the French *putte*, *whore*; *putagium*, q. d. *putam agere*. "Quod autem generaliter solet dici, putagium hereditatem non admittit; illud intelligendum est de putagio matris; quia filius hæres legitimus est, quem nuptie demonstrant." Glanv. lib. vii. cap. 12.

PUTALA, in *Geography*. See PATELI.

PUTALLOM, a town on the coast of Ceylon, near Calpenteen, remarkable for its salt-pans. This place, before the arrival of Europeans on the island, supplied the natives with salt; and on account of its convenient situation, was pitched upon by the Dutch for the manufacture of the salt with which they supplied the king of Candy's dominions, according to the articles of their treaty with him. The salt-pans are formed by an arm of the sea which overflows part of the country between Putallom and Calpenteen. A very large quantity of salt was manufactured here by the Dutch; they looked upon it as of the highest importance to their interests in the island, and the most formidable weapon which it was in their power to employ against the native king, as it was impossible for him to procure any but through their means. Since the British have obtained possession of the island, this manufacture has been almost entirely neglected. It is capable, however, of being rendered very profitable, as it is the only one of the kind on this side of the island, and the most conveniently situated for supplying the king of Candy's dominions. The Dutch enacted very severe laws to prevent individuals from manufacturing or trading in this article; the government taking upon itself the management of the works, and the care of supplying both its own subjects and the Candians. In order to keep a constant check on the latter, the Dutch were careful not to allow them too great a quantity at once; and whatever remained at Putallom, after supplying the demands of each year, they destroyed, that it might not be seized upon by surprise.

PUTANGES, a town of France, in the department of the Orne, and chief place of a canton, in the district of Argentan; nine miles N.W. of Argentan. The place contains 502, and the canton 11,934 inhabitants, on a territory of $212\frac{1}{2}$ kilometres, in 31 communes.

PUTANISM, PUTANISMO, an Italian term, naturalized by some English writers, signifying *whoredom*, or the life or condition of a courtesan.

The word we borrow immediately from the French, *putanisme*; and they from the Italian *puttana*, *whore*; of *putta*, *girl*.

PUTAO, in *Geography*, a town on the S. coast of the island of Luçon. S. lat. $13^{\circ} 6'$. E. long. $123^{\circ} 28'$.

PUTATIVE, SUPPOSITIVE, something reputed to be what it really is not.

The word is seldom used but in the phrase putative father.

Thus we say, Joseph was the putative father of Jesus Christ.

PUTAVERI, in *Biography*, a native of Otaheite, brought into France by the circumnavigator Bougainville: of whom a gentleman, who had resided a considerable time in Italy, and was an excellent judge of music, assured us that the effects of French music, when fairly tried upon him immediately on his arrival, were not those of rapture, but ridicule. He danced to it, indeed, as we would to a marked measure beat on a drum or a table; for as soon as he returned from the great opera, whither he was carried, he mimicked what he had heard and seen in the most natural and ridiculous manner possible; giving the company a specimen of the French opera, which was the most admirable parody imaginable of French singing, or rather of the screams and howlings at the Académie Royale de la Musique in the time of Louis XV. Our friend wished to try the effects of Italian music upon this demi-savage native of Otaheite; but there was no opportunity, for how could it be properly executed at Paris? However, according to the late lord marshal, the experiment had been fairly made on another occasion.

A young Greek lady being brought from her own country to Paris, some years since, was, soon after her arrival in that city, carried to the opera by some French ladies, supposing, as she had never heard cultivated music, that she would be in raptures at it; but, contrary to those expectations, she declared that the singing only reminded her of the hideous howlings of the Calmuc Tartars, and as to the machinery, which it was thought would afford her great amusement, she proclaimed her dislike of many parts of it, and was particularly shocked by what she called the impious and wicked imitation of God's thunder. Soon after this experiment she went to Venice, where another trial was made on her unprejudiced ears, at an Italian opera, in which the famous Gizziello sung, at whose performance she was quite dissolved in pleasure, and was ever after passionately fond of Italian music.

PUTAWATAMES, or POOTOOTAMIES, in *Geography*, Indians who inhabit between St. Joseph's and Detroit in North America, and can furnish about 500 warriors. There are two tribes of this name, the one of the river St. Joseph, and the other of Huron. At the treaty of Greenville, August 3d, 1795, they ceded lands to the United States, who paid them a sum of money, and engaged to give them goods to the value of 1000 dollars *per annum*, forever.

PUTBUS, a town and fort of the island of Rugen; five miles S. of Bergen.

PUTCABARY, a town of Hindoostan, in Bengal 45 miles S.E. of Moorshedabad.

PUTEA, in *Ancient Geography*, a town of Africa propria, S. of Adrametum, between Campsa and Caraga, according to Ptolemy.—Also, a town of Syria, in the Palmyrene, between Oriza and Abada. Ptol.

PUTEAL, among the Romans, a small kind of edifice raised in the place where a thunder-bolt had fallen. See BIDENTAL.

PUTELKAW, in *Geography*, a town of Prussia, in the province of Ermeland; six miles S.W. of Frawenburg.

PUTEMAHRY, a town of Hindoostan, in Bengal 16 miles N. of Kishenagur.

PUTEOLANUS PULVIS. See POZZOLANA.

PUTHLOSE, or PUTLOS, in *Geography*, a town in the duchy of Holstein; four miles N.W. of Oldenburg.

PUTI, or PORI, a town of the principality of Gurie

at the mouth of the Rione, on the Black sea; 80 miles W.S.W. of Cotatis. N. lat. 42° . E. long. $41^{\circ} 28'$.

PUTICULLI, among the Romans, ditches or holes in the earth, a little without the Esquiline gate, in which the poorer sort of people were buried.

PUTIGNANO, in *Geography*, a town of Naples, in the province of Bari; 33 miles S.E. of Bari.

PUTIVLI, a town of Russia, in the government of Kursk, on the Sem; 72 miles W.S.W. of Kursk. N. lat. $51^{\circ} 20'$. E. long. $34^{\circ} 14'$.

PUTLACH, a town of Bavaria, in the bishopric of Bamberg; five miles E. of Gossweinstein.

PUTLITZ, or **PUDLITZ**, a town of Brandenburg, in the Mark of Prenzitz; 10 miles N. of Perleberg. N. lat. $53^{\circ} 16'$. E. long. $12^{\circ} 3'$.

PUTLOGS, or **PUTLOCKS**, in *Building*, short pieces of timber, about seven feet long, used in building scaffolds. They lie at right angles to the wall, with one of their ends bearing upon it, and the other upon the ledges or poles which stand parallel to the side of the wall of the building.

PUTNA, in *Geography*, a town of Moldavia; 32 miles W. of Suczava.—Also, a river of Moldavia, which runs into the Milcow, at Focfani.

PUTNAM, a county of America, in the southern district of Georgia, containing 6809 free persons, and 3220 slaves. Its chief town is Eatonton.

PUTNEY, a town of America, in Windham county, and state of Vermont, containing 1607 inhabitants.

PUTNEY, a village and parish in the west half hundred of Brixton, and county of Surrey, England, is situated on the south bank of the river Thames, at the distance of four miles from Hyde Park corner, London. The parish contains 1630 acres, of which the greater proportion is an open common or heath. In the time of the civil wars it was the scene of some very interesting transactions. The parliamentary army lay at Putney, for a considerable time, in the year 1747; and here the general officers, after long debates in the church, completed their propositions for the future government of the kingdom, and sent them to the king at Hampton Court. Here also were born two celebrated statesmen, Nicholas West, bishop of Ely, and Thomas Cromwell, earl of Essex, the protégé of Wolfey, and the successor to his power and misfortunes. In this parish are many agreeable villas; in one of which the late illustrious William Pitt breathed his last. The church was originally built as a chapel of ease to Wimbledon, not long after the conquest; but was, in a great measure, re-erected in the reign of Henry VII. It is a small edifice, with a stone tower at the west end. A little chapel at the eastern extremity of the south aisle, built by bishop West, is, however, its chief ornament. Monuments and inscriptions are numerous, but few of them deserve notice. Over the Thames, in this parish, is a wooden bridge, constructed in the year 1729, at the expense of 23,975*l.* and yielding a revenue, by tolls, to the proprietors, of above 3000*l.* per annum. A fishery here was possessed by the lord of the manor, previous to the conquest; and is now rented for a considerable sum. All sturgeons and porpuses are claimed by the lord mayor of London, but the fishermen receive 13*s.* for each of the former, and a guinea for each of the latter, when delivered to the water bailiff. On the common stands an obelisk, erected, in 1786, in memory of Hartley's invention for securing buildings against fire.

According to the parliamentary returns of 1811, this parish contains 492 houses, and 2881 inhabitants. Lysons's *Environs of London*, vol. i. 1795. Supplement, 1811.

PUTNOK, a town of Hungary; 36 miles W.N.W. of Tokay.

PUTORIUS, in *Zoology*, the *Pole-cat*, a species of *Mustela*; which see. See also **POLE-CAT**.

PUTORIUS *Serpens*, a name given by some to that species of serpent called by others *dryinus*.

PUTREFACTION, or **PUTRIFACTION**, in *Chemistry*, is a species of *fermentation* (which see); being the last stage of the fermentatory process, and consisting not merely in the decomposition and transposition of the particles of putrefying substances, whether animal or vegetable, by which new combinations are produced, but also in the extrication and expulsion of some of the constituent parts of these substances.

This decomposition or derangement of the constituent parts of vegetable substances is usually called *fermentation*, and that of animal bodies, is denominated *putrefaction*. The agents that produce both kinds of decomposition, and the circumstances that attend them are, in various respects, very similar, and the chief difference of the products that are obtained from both depends upon the diversity of their constituent parts. The process of putrefaction, and its effect in dissolving the combination of the constituent parts of bodies, are sufficiently obvious to sense; but the rationale of the process, and the mode in which gaseous and volatile compounds are separated from bodies that are disorganized and afterwards form new combinations, are still involved in considerable obscurity; and different writers have disagreed in their explication of them. Several facts, however, are universally acknowledged; and of these we shall give a brief account in the sequel of this article, together with a detail of some of those principles and theories that have been adopted for explaining them. Becher long ago observed, in his "*Phys. Subt. l. i. §. 5.*" that air is the principal agent of decomposition, but that water and heat very much facilitate its action. Thus he says, "*Fermentatio ergo definitur quod sit corporis densioris rarefactio, particularumque ærearum interpositio; ex quo concluditur debere in aëre fieri nec nimium frigido, ne rarefactio impediatur; nec nimium calido, ne partes raribiles expellantur.*"

An animal substance may be preserved from putrefaction by depriving it of the contact of the air; and this process may be accelerated or retarded by varying or modifying the purity of the same fluid. When we observe putrefaction occurring without the access of atmospherical air, the effect is produced by the water which impregnates the animal substance, becomes decomposed, and affords the element and the agent of putrefaction. Hence it appears, that moisture is an indispensable requisite to facilitate putrefaction. A moderate degree of heat is also a condition favourable to animal decomposition.

Dr. Hales, it is well known, ascribed the cohesion and solidity of bodies to the air, which exists in them in a fixed state, and forms, as he expresses it, the cement or bond of union between their several constituent particles. To this purpose he observes, that air abounds much more in solid than in liquid bodies; and that solid bodies being generally denser than water, the attraction of the air of these solid bodies in a fixed state, and its repulsion when in an elastic state, are greater than the attraction and repulsion of the lighter watery particles in a fixed and in an elastic state; and hence the particles of air are fitter to be the principal bond of union in solid bodies, than the particles of water. This opinion was afterwards adopted by baron de Haller, who maintains, that air is the *vinculum elementorum primum*, or the true cement which binds together the earthy particles

particles of bodies. Mr. Macbride, as we have elsewhere shewn, has taken occasion, by a variety of experiments, to illustrate and establish this opinion; and in support of it he alleges, that the preservation of firmness and soundness in bodies depends on restraining the escape of that principle, since known by the name of fixed air, and which he supposes to be the immediate cause of cohesion: for the moment it flies off and resumes its elasticity, the other constituent particles, *viz.* the earthy, the saline, the oily or inflammable, and the aqueous, being thereby put in motion, immediately begin to exert their several peculiar attractive and repulsive powers, and run into new combinations, which first change, and at length altogether destroy the texture of the substance they formerly composed; provided that this substance contained in itself a sufficient quantity of water to allow of the intestine motion, by giving the proper degree of fluidity; for without fluidity there can be no intestine motion; and without intestine motion there can be no change of combination: because we see that such animal and vegetable bodies as are suddenly deprived of their water, or naturally contain very little, are almost as durable and unchangeable in their texture as minerals. Hence Acoſta observes, that in Peru, and others have observed the same in Egypt, where it very rarely rains, every thing will continue a long time uncorrupted; unless we should rather ascribe this effect to the abundance of nitrous salt in the air of those places, which is known to resist putrefaction. Indeed all putrefactions, both of animal and vegetable bodies, are affirmed by the learned Boerhaave to be performed by means of water alone. Take, says he, a pound of fresh flesh, and keep it in a heat like that of our body, and, in a few days the putrefaction will be completed; but if you first drain out, or exhale, all the watery part from the same in some chemical vessel, though the salt and oil remain, the flesh will harden like a stone, and may be kept for ages without putrefaction. Though when thus hardened, water poured on it, or even the common dew, will soon set it a putrefying. Thus Villaris and Cazalet of Bourdeaux, as Chaptal informs us, dried meat by means of stoves, which was preserved for several years without contracting any bad flavour.

By such means, bread, flesh, or the like foods, may be preserved for many ages; provided regard be had to the place. Hence it is that in dry countries, as Egypt, dead carcases never putrefy, but dry and harden uncorrupted: as we see also in the mummies found buried under the sand.

The sands and light porous earths preserve human bodies by exhausting their juices and drying the solid parts. Hence it is, that entire caravans have been discovered in Arabia, consisting of men and camels, preserved in the sands under which the impetuous winds have buried them. In the library of Trinity college, Cambridge, a human body may be seen in a perfect state, which was found under the sand in the island of Teneriffe. Hence substances putrefy much more slowly when exposed to a drying wind, than in a sheltered place.

Nevertheless, too much humidity impedes putrefaction. To this purpose Becher observes: "*Nimia quoque humiditas a putrefactione impedit, prout nimius calor; nam corpora in aqua potius gradatim consumi quam putrefcere, si nova semper affluens sit, experientia docet: unde longo tempore integra interdum submersa prorsus a putrefactione immunia vidimus; adeo ut nobis aliquando speculatio occurreret, tractando tali modo cadavera anatomiae subjienda, quo diutius a fetore et putrefactione immunia forent.*" Accordingly it is necessary, that in order to a body's putre-

fying by moisture, that the water should impregnate but not inundate it. It is also necessary, that it should remain in the texture of the animal body, without being renewed; for thus the lymph is dissolved, and the most putrescible substance is presented to the air with the greatest extent of surface; and the water itself is decomposed, and by this means affords the putrefactive principle.

Even human blood, which, naturally, is so prone to putrefaction, if you deprive it of its watery part, may be kept for fifty years. Goat's blood, we actually find kept so long in the shops, without corrupting; though, if you dissolve it in water, and expose it to a gentle warmth, it will putrefy immediately. Blood is said to be the most putrescent animal substance that is known; and this property is ascribed partly to its fluidity and partly to the large quantity of fibrin and uncondensed albumen, which it contains, and especially to the former. See BLOOD.

We shall here add, that animal substances seem to be (*cæteris paribus*) more putrescent in proportion to the number of constituent parts which they contain. The substances either absolutely or nearly imputrescible are bone and condensed albumen, the latter being such as exists in cuticle, nail, hair, &c. which long remain unaltered in the midst of putrefying substances. Animal oil also putrefies with great difficulty, and hence the people that live in the most northern parts of America, the Esquimaux and others, preserve fish and meat to a certain degree from putrefaction by immersion in fish-oil.

In putrefaction there is a great intestine motion, which, when carried to an extreme, and when the putrefying substance is much compressed, is accompanied with heat and smoke, and sometimes flame. However, M. Beaumé affirms, that putrefaction is not attended with any sensible heat: when, indeed, it proceeds slowly, and the quantity of putrefying matter is but small, the heat, if any, is very little. That putrescent substances emit light, is an unquestionable fact; and on this principle philosophers account for the luminousness of the sea, the *ignis fatuus*, &c. To this purpose M. Ant. Martin (Swed. Abhad. vol. xxiii. p. 225, cited by Dr. Priestley, in his History of Light, &c. p. 576.) observes, that human bodies have sometimes emitted light about the time they begin to putrefy; and that the walls and roof of a place in which dead bodies had often been exposed, had a kind of dew or clamminess upon them, which was sometimes luminous. And he imagines, that the lights which are said to be seen in burying grounds may be owing to this cause. It has been observed, that heat extinguishes the light of putrescent substances; Mr. Canton, attending to this circumstance in some experiments for ascertaining the cause of the luminousness of the sea, remarks, that though the greatest summer-heat is well known to promote putrefaction, yet twenty degrees more than that of the human blood seems to hinder it; for putting a small piece of luminous fish into a thin glass ball, he found that water of the heat of one hundred and eighteen degrees would extinguish its light in less than half a minute; but that on taking it out of the water, it would begin to recover its light in about ten seconds: but it was never afterwards so bright as before. See LIGHT.

It has been observed, that a temperature from about forty degrees to the highest natural heat is favourable to the putrefaction of animal matter, whereas a freezing temperature is known to stop putrefaction, as it is the custom in cold countries to bring victuals frozen to market, and in this state they are kept for any length of time without any other preparation; and besides, bodies of men or of other animals remain unaltered under ice for many weeks. We

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might allege many other circumstances of a similar nature. On the other hand, a scorching heat also prevents putrefaction; probably by expelling the moisture which is essential to the process, because by an inferior degree of heat putrefaction is promoted. The influence of temperature on animal putrefaction is thus stated by Becher: "*Aër calidus et humidus maximè et putrefactionem facit—corpora frigida et sicca difficulter, imò aliqua prorsus non putrescunt: quæ ab imperitis proinde pro sanctis habita fuere; ita aër frigidus et siccus, imprimis calidus et siccus, a putrefactione quoque preservat: quod in Hispania videmus, et locis aliis calidis, sicco, calido aëre præditis, ubi corpora non putrescunt et resolvantur; nam cadavera in oriente in arena, imò apud nos arte in furnis, siccare, et sic ad finem mundi usque à putredine præservari, certum est: intensum quoque frigus à putredine præservare: unde corpora Stockholmiae tota hyeme in patibulo suspensa sine putredine animadvertimus.*" From the facts already stated, we may deduce the most effectual means of preventing, and increasing putrefaction, and also of modifying it at pleasure. A body may be preserved from putrefaction by depriving it of the contact of atmospheric air: for this purpose nothing more is required than to place the body in a vacuum, or to envelope it in a covering, which may defend it from the immediate action of air; or also to envelope it in an atmosphere of some gaseous substance, which does not contain vital air. Putrefaction may also be favoured by keeping bodies at a suitable temperature. A degree of heat from between sixty-five and ninety degrees diminishes the adhesion of the parts, and favours the action of the air; but if the heat be greater, says Chaptal, it volatilizes the aqueous principle, dries the solids, and retards the putrefaction. Hence it is inferred, that for the decomposition of an animal substance, it is necessary that it should have the contact of atmospheric air, and that the purer the air is, the more speedy will be the putrefaction: that it be exposed to a moderate degree of heat: and that its texture be impregnated with humidity.

The most sudden and remarkable changes produced upon a body by putrefaction, are upon its colour, smell, and taste. Flesh beginning to putrefy, is well known to exhale very soon after a penetrating foetid smell, its colour becomes pale, then inclining to blue, and afterwards livid and black, and its taste nauseous. Transparent liquor, as urine and broth, during putrefaction, becomes also turbid: as the putrefaction advances, the smell becomes more and more foetid, and it also acquires great pungency, which is caused by a large quantity of volatile alkali, disengaged from those substances that are completely putrefied. Solid bodies, whilst they are putrefying, swell, become soft, lose the cohesion of their parts, and are lastly reduced to a very disagreeable putrid pulpy mass: the fluids become turbid, and the effluvia are loathsome and sickening, and after a time a putrid gas is disengaged in a slow but sensible effervescence. A foul and brown serum then sweats out from the pulpy mass, and about this time the effluvia is very sensibly ammoniacal, which is indicated by its effects on the eyes and throat, and by forming a white vapour with muriatic acid gas. For some time a large part of the putrid substance is evaporated, and carried off in the putrid gas and dispersed in the atmosphere, after which the extreme fætor subsides; and finally the process of putrefaction ceases, and leaves a kind of fat foetid earthy matter. All the gases certainly known to be produced by putrefaction, are carbonic acid, carburetted hydrogen, sulphuretted and phosphuretted hydrogen, and ammonia; but either these, or some of these, must be considerably changed by the solution of the animal matter;

or some compound not yet examined, must be produced in that state of putrefaction, when the gas evolved occasions such dreadful effects upon those that have the misfortune to fall in the way of it, even when diluted considerably with common air. This is said to be the case when the abdomen of a large animal is first burst, after some days or perhaps weeks of putrefaction; the gas from which causes instant fainting, and sometimes death, and even when the person exposed to it receives the first shock, it leaves excessive debility and other alarming symptoms for a considerable time. The most deleterious gas that is known is, perhaps, carburetted hydrogen, but the effects of this, as obtained by chemical means, are far short of those above-mentioned, when equally diluted. The generation of ammonia has been satisfactorily accounted for, since the discovery of the constituent parts of the volatile alkali, by the new combination formed between the azote of the animal matter, and the hydrogen, of which latter there are many sources, and particularly that of the decomposition of water. As ammonia is always produced during putrefaction, it seems rational to suppose, that one important purpose of the moisture necessary to the process, is to afford, by its decomposition, the hydrogen of the volatile alkali. The nitrous acid is also an undoubted product of putrefaction; but farther experiments and facts are necessary for explaining the reason, why in some cases the azote tends to unite with oxygen to form this acid, and in others with hydrogen to form ammonia. For an account of the peculiar changes which animal flesh undergoes, by which it is converted into a spermaceti-like substance, instead of passing through the usual process of putrid decomposition, we refer to the article ADIPOCIRE.

Sir John Pringle has observed, that, as all the humours of all animal bodies become thinner by putrefaction, so the solid or fibrous parts are thereby relaxed, and rendered tender: and hence the extraordinary bulk of the heart, liver, and spleen, incident to persons labouring under putrid diseases, may be accounted for. It is remarkable, that in dissections of persons who die of the plague, the heart is almost always found of an uncommon magnitude; and as to the scurvy, the liver and spleen are sometimes enlarged to such a degree, that the tumour may be seen outwardly.

From matters completely putrefied may be obtained by distillation volatile alkali, some liquid and some solid; a pungent foetid oil, which at first is thin, and afterwards becomes more thick; and a residuum of coal, not easily reducible to ashes. Some writers on this subject have apprehended, that putrid substances are not to be regarded as alkaline. Sir John Pringle, finding from the experiments which he made in the year 1750, that syrup of violets was not changed into a green colour by the serum of putrid blood; that this serum did not make any effervescence, when spirit of vitriol was poured upon it; that water, in which corrupted flesh had been for some time infused, neither effervesced nor changed the colour of the syrup; and that alkaline salts, both fixed and volatile, powerfully oppose putrefaction; was led to adopt this opinion. But when he became acquainted with the experiments made by M. J. Bapt. Gaber of Turin (*Acta Taurinens.* vol. i. p. 78, &c.) he embraced with the liberality of a true philosopher, the first opportunity of acknowledging his mistake. M. Gaber, having poured a drop or two of aqua fortis upon bile, taken out of the gall-bladder of a person who had died of an inveterate jaundice without a fever, and whose body had lain about twenty-four hours in a cold place in winter, found, that the mixture immediately effervesced, became sensibly warm, and that several air-bubbles rose to the surface. He also exposed the remainder of this bile in three open glasses

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to the thirty-fifth, twenty-fifth, and tenth degrees of heat, indicated by Reaumur's thermometer, and at the end of twenty-four hours mixed them with acids; and he found, that the bile which had been placed in a degree of heat answering to thirty-five, was most dilated, and gave very slight indications of effervescence; that which had stood in twenty-five was also dilated, and the acid produced a more sensible effervescence, but still very slight; and the bile which had been exposed only to the temperament of the air, varying from seven to ten, preserved its tenacity, and fermented as much as that in his first experiment. Having mixed some blood, taken out of a vein of the dead body at the same time, and which appeared to be of the yellowish-red, with spirit of nitre, the mixture effervesced, but in a much less degree than the bile: this mixture, being left to digest for some hours, a yellow serum separated from the blood, and covered its whole surface; and the blood, being subjected to the same heat as the bile, and for the same time, appeared more disposed to effervesce than the bile, though this disposition afterwards gradually diminished. From these experiments the ingenious writer infers, that in diseased bodies the humours may become so alkalescent as to effervesce with acids: that a very slight degree of putrefaction and fœtor, which is not sufficient to produce alkalescence out of the body, will produce it in the body; that alkali formed in the body, and contained in the bile, is extremely volatile, since the heat of twenty-five degrees made a great part of it evaporate; and that the same alkali contained in the blood, being a little more entangled with other elements, is consequently less volatile, since the same degree of heat continued for the same time, dissipated but a very inconsiderable part of it: and, therefore, that the different phenomena taken notice of by those who have prosecuted experiments of this kind, some of whom affirm that they have seen undoubted proofs of the presence of an alkali, and others that they have scarcely discovered any such indications at all, are the effects of different degrees of heat, the flatulency of the substance exposed to the heat, or the different volatility of the alkali arising from its cohesion with other principles. Having made similar experiments upon healthy bile, blood, and serum, and submitted them to the action of mineral acids, he found the bile most disposed to effervesce; that human bile was more disposed to effervesce than the bile of an ox; that corrupt blood ferments with acids still slower; and that serum ferments slower than blood. He also observed, that putrescent humours not only effervesce with mineral acids, but with very weak distilled vinegar: and that those humours that have been exposed to artificial heat, become fœtid and effervesce soonest, and soonest arrive at the last stage of fermentation; in which case the fermentation ceases, though the heat is continued; and the smell, which till then is intolerably fœtid, becomes herbaceous, and is not disagreeable. The fœtor, he says, manifests itself sooner and lasts longer than the alkalescence.

M. Gaber farther observes, in relation to the experiments of sir John Pringle, that at the degree of heat to which he exposed putrescent substances, and which was equal to the hundredth degree of Fahrenheit, corresponding nearly to the thirtieth degree of Reaumur, animal humours very soon become putrid; but that they as soon lose the alkalescence which they derive from putrefaction, if this degree of heat is continued: so that as the corrupting humours manifest their alkalescent quality only for a very short time, it might easily happen that no sign of alkalescence appeared in his experiment, if it was not made in the critical moment, *i. e.* if he examined the putrescent humours a little before the alkali was formed, or a little after it had evaporated. And he,

therefore, apprehends, that if sir John Pringle's experiments were made with a degree of heat just equal to his own, the result, *ceteris paribus*, must have been the same.

From other experiments this writer infers, that blood received from the arm, agitated and left to putrefy, does not putrefy so soon, nor so soon manifest signs of alkalescence, as the red part separated from the serum, because the serum putrefies more slowly than any other animal humour; and that the alkali, which evaporates with a degree of heat from twenty-five to twenty-eight of Reaumur, being collected in a receiver, will effervesce, and that the residuum is a mass extremely fœtid, wholly destitute of alkali, and, consequently, that no effervescence is to be expected by pouring acids upon it. Having kept some blood in a glass vessel close stopped, he found that it retained its alkalescence a long time, though exposed to a degree of heat equal to twenty-five; but upon unstopping the vessel, it flew off with great violence, in an extremely fœtid vapour. These explosions he attributes to the expansion of the air, in consequence of the putrefaction; and hence he deduces the reason, why the humours that are contained in the vessels of a human body become alkalescent while they are yet scarcely fœtid, although when drawn from the body, and kept in open vessels, they become fœtid, before they give signs of alkalescence. As soon as they begin to form alkali in the vessels, the alkali is retained; but as it exhales from vessels exposed to the air, a greater quantity must be formed than exhales before it can become sensible. Having collected the distilled liquor of blood in such a state of putrefaction as to effervesce with acids, and exposed it to the action of various acids, a violent effervescence ensued; and when poured upon syrup of violets, it produced as fine a green as spirits of hartshorn; and this tincture, having been changed into a red by the effusion of a few drops of aqua fortis, became again blue, upon pouring into it some more of the distilled liquor; whence he concludes, that putrescent humours form a true alkali, which exhales with a very slight heat. From other experiments he infers, that the alkali of putrescent substances is not the productive cause of their fœtor, because the latter remains when the former is departed. But as both appear in the same degree of heat, when long continued, it appears, he says, that this fœtor is produced by the effluvia of parts extremely volatile, but different from volatile alkali, which, though sooner produced, are more slowly dissipated. Alkalescence, however, may be sometimes connected with a slight fœtor; and, on the contrary, extreme fœtor may subsist without alkalescence. And this fact confirms the observation of sir John Pringle, who found a difference between the fœtid and alkaline particles; since the exhalations of fresh urine are not pernicious, though they contain more alkali than any substance in a state of putrefaction, the odour of which is pernicious in the highest degree; and, therefore, putrid effluvia are of a different nature from alkaline salts. M. Gaber farther adds, by way of inference from this fact, that a volatile alkali is not a necessary product of putrefaction, and that the degree of alkalescence is not equal to that of putrefaction. Dr. Crell, professor of chemistry at Brunswick, has objected to this doctrine, as not conformable to the phenomena (Phil. Trans. vol. lxi. part i. art. 39.); for he supposes, that as all smell depends on a saline matter joined with phlogiston, and the saline matter producing the putrid stench was very probably not an acid, it must be a volatile alkali, which, involved in phlogistic matter, might fly off before the alkali was developed. From some experiments made with a view of ascertaining this fact, he infers that the volatile alkali is present as long, at least, as the putrid smell continues, and that this volatile alkali is the basis of it; because, as this was

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distilled over in his experiments, the residue, being still in intestine motion, required only the herbaceous smell. The reason why the volatile alkali has been distinctly observed at a certain period of putrefaction, and not in the other, he apprehends to be this: the volatile alkali has, it seems, a tendency to disentangle itself, by intestine motion, of all such matter as it is involved with; but if it is not combined with such fixed matter as retains it till it has gone through all its evolutions, it is, being itself volatile, carried off by the still more volatile phlogistic matter with which it is commonly joined. For this reason, he supposes the putrefying matter shews in its beginning no signs of volatile alkali, because its smell depends only on those particles which have been on the surface, without any strong cohesion with the substance. In the farther progress of putrefaction, the matter involving the alkali, or forming it, is intermixed, and in cohesion with the solid particles of the substance, and is by these means retained till the alkali is come to its purer state. Towards the end of putrefaction, the cohesion of the particles being almost entirely taken off, the volatile alkali is carried off before it can go through all its states.

Dr. Macbride made several experiments with putrid blood and putrid bile, which ascertain the fact, that as soon as an animal substance begins to putrefy, it begins to discover an alkaline quality; and this volatile matter, now produced in it, may be separated by distillation in a very gentle warmth; but he observes, that the volatile alkali obtained from putrid substances is not exactly similar to that obtained by violent heat from animal substances not putrid. It differs remarkably in the flavour, which is nauseous and disagreeable, is not so pungent, and is much weaker than the common volatile alkali; and this latter is capable of dissolving the putrid alkali, and of driving it off from any body to which it has been united. But to return from this digression. As to the cause and process of putrefaction, it has been generally believed, that the contact of atmospheric air is necessary for this purpose, and that bodies become putrid, because air communicates somewhat to them: accordingly it has been alleged, that bodies buried deep under the earth, or in water, out of the reach of any air, have remained entire for ages; which, when exposed to the open air, have soon rotted and mouldered away. It is also well known, that bodies are preserved from putrefaction by covering them with wax, suet, &c.; and Mr. Boyle relates, that he has preserved lemons, oranges, and other fruits, from putrefaction, during several years, by including them in an exhausted receiver. Experiments of the same kind have been lately made by M. Eller of Berlin, which shew that substances, even of the most putrescent nature (such as blood) may be kept sound *in vacuo* for many years. But Dr. Macbride has urged a variety of facts and considerations to prove, that putrefaction ensues in consequence of the loss of some principle, which cemented the constituent particles of bodies, and that, when this is disengaged from them, they separate, and are disunited. This principle he discovered to be air, which, in putrefaction and fermentation, is extricated and thrown off, from a fixed and non-elastic state, into one that is volatile and elastic; but which immediately, upon meeting with a proper recipient, returns again to its former nature. Thus he found, that caustic alkali and quicklime may be rendered mild by absorbing this air, extricated from putrefying and fermenting substances; that without the extrication of this air no putrefaction can happen; and that even by absorption of it, putrefied substances may be corrected and rendered sweet. To the same purpose Dr. Alexander has endeavoured to prove, that putrid matter will preserve other substances from putrefaction; which is not improbable, be-

cause, being already saturated with the putrid effluvia, they cannot readily take any more. Dr. Macbride, having exposed putrid matters to the vapours arising from fermenting mixtures, or from alkaline substances effervescing with acids, found that the putrid quality was destroyed; and hence he considers the fixed air as powerfully antiseptic. And it appears also from the experiments of Dr. Priestley, that fixed air corrects and renders wholesome air tainted with respiration or putrefaction. Hence he infers, that lime-kilns, which discharge great quantities of this air, may be wholesome in the neighbourhood of populous towns, the atmosphere of which must abound with putrid effluvia. Sir William Lee, in a hot season, contrived, by impregnating water with fixed air, in the manner described under *Pyramont water*, and washing meat with it two or three times a-day, not only to preserve it as perfectly sweet and good to the extent of ten days, as at the first killing, but also to recover some meat that had begun to change. And it is farther well known, that fixed air, or carbonic acid, has been lately introduced into the materia medica, and administered with success in a variety of putrid cases. Dr. Macbride has also proved, that putrefaction is accelerated by taking off the pressure of the atmosphere; and from some experiments he was led to conclude, that it will take place sooner in *vacuo* than in the open air; but making a more complete vacuum by means of two brass hemispheres joined together, he found that the observation of Mr. Boyle and others was agreeable to fact. It appeared also, by inclosing flesh in condensed air, that increasing the pressure of the surrounded air, retarded putrefaction; and hence he deduces, what he deems to be a demonstrative proof, that bodies do not putrefy, because the air adds somewhat to them; for if they did, then a piece of flesh which lay in condensed air ought to have putrefied the soonest, because it had the greatest quantity of air applied to its surface. But the reason why, according to his system, condensed air prevents putrefaction is, that the pressure of every side must force the constituent particles closer together, thus increase their cohesion, and prevent the intestine motion; and without intestine motion there can be no change of combination. However, it is observed by sir John Pringle, that the putrefaction of meat and other substances, advances quicker in a confined than free air; for as the most putrid parts are also the most fugitive, they incessantly issue from a corruptible substance, and disperse with the wind; but in a stagnation of air they remain about the body, and in the nature of a ferment excite its corruption.

It has been long observed, that putrefaction generates air. Hence, though flesh, as well as blood, be specifically heavier than water, yet dead bodies are found to float, after lying some time at the bottom, from air generated in the bowels by putrefaction. And since it has been found by experiments, that the blood and other animal substances begin to emit air before they are so far corrupted, as they frequently are in putrid diseases, it is probable that several of the symptoms in deep surfeits may be owing to the action of the confined air. As dead bodies become putrid from the loss of their fixed air, according to Dr. Macbride's theory, he suggests, that the immediate cause of putrefaction in living bodies may be the detachment of too large a proportion of their fixed air. This fact he endeavours to evince by an enumeration of the symptoms that occur in the scurvy, and other highly putrid diseases, which shew that the air is actually detached from the blood in such cases; as well as from an examination of the principal and prevailing causes of such disorders. And since the air tainted with animal or vegetable putrefaction is the same with air rendered noxious by animal respiration; since both equally extinguish flame,
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are equally noxious to animals, are equally and in the same way offensive to the smell, equally precipitate lime in lime water, and are restored by the same means, Dr. Priestley suggests, that one use of the lungs is to carry off the putrid effluvia, without which, perhaps, a living body might putrefy as soon as a dead one. See BLOOD and RESPIRATION.

We shall here observe, that putrifying and fermenting substances have been found, by the experiments of Mr. Cavendish, Dr. Priestley, &c. to yield not only *fixed* but *inflammable* air. From an experiment of Dr. Priestley, intended to determine the proportion of each of the kinds of air in the different stages of the putrefactive process, it appears that a piece of mutton weighing four penny-weights six grains, yielded in all $2\frac{1}{4}$ measures of air, of which $2\frac{1}{4} \times \frac{5}{6}$ was fixed, and the rest inflammable; and that all the inflammable part was exhaled a considerable time before the fixed air. The same ingenious writer has observed, that the diminution of common air, by means of putrefaction, amounts to a complete fourth part of the whole, notwithstanding the production of some permanent air from the putrefying substance, and has, in all respects, the appearance of being produced solely by the precipitation of fixed air. It must occur to every reader, in any way acquainted with this subject, if the phlogistic theory be admitted, (which indeed is now generally discarded,) that if inflammable air be the same with phlogiston, as Dr. Priestley seemed to have discovered, many of the phenomena of putrefaction, depending on this principle, such as the smell, colour, light, &c. will probably from hence admit of an easy explication.

We shall here subjoin some observations with respect to the decomposition of animal bodies that are interred in burying-grounds. In this situation, the decomposition is four times as slow as when the putrefying animal is exposed to the air. It is not perfectly ended, according to Mr. Petit, till three years after the body has been interred, at the depth of four feet; and it is slower in proportion as the body is buried at a greater depth. These facts agree with the principles which we have already established for bodies buried in the earth, and subjected to laws of decomposition very different from those which take place in bodies exposed to the open air. In this case, the decomposition is favoured by the waters which filter through the earth, and dissolve and carry with them the animal juices. It is also favoured by the earth, which absorbs the juices with more or less facility. Messrs. Lemery, Geoffroy, and Hunaud, have proved that argillaceous earths exert a very slow action upon bodies; but when the earths are porous and light, the bodies then dry very speedily. The several principles of bodies absorbed by the earth, or carried by the vapours, are dispersed through a great space, imbibed by the roots of vegetables, and gradually decomposed. This is what passes in burying-grounds in the open air; but it is very far from being applicable to the sepulchres which are made in churches and covered places. Here is neither water nor vegetation; and consequently no cause which can carry away, dissolve, or change the nature of the animal fluids: and we cannot but applaud the wisdom of government, which has prohibited the burying in churches; a practice which was once a subject of horror and infection.

The accidents which have happened at the opening of graves and vaults are but too numerous, to render any apology necessary for our speaking a few words respecting the method of preventing them.

The decomposition of a body in the bowels of the earth can never be dangerous, provided it be buried at a sufficient depth, and that the grave be not opened before its entire and

complete decomposition. The depth of the grave ought to be such that the external air cannot penetrate it; that the juices, with which the earth is impregnated, may be conveyed to its surface; and that the exhalations, vapours, or gases, which are developed or formed by decomposition, should not be capable of forcing the earthy covering which detains them. The nature of the earth in which the grave is dug, influences all its effects. If the stratum which covers the body be argillaceous, the depth of the grave may be less, as this earth difficultly affords a passage to gas and vapour; but in general it is admitted to be necessary that bodies should be buried at the depth of five feet, to prevent all these unhappy accidents. It is likewise necessary to attend to the circumstance, that a grave ought not to be opened before the complete decomposition of the body. This decomposition, according to Mr. Petit, is not perfect until the expiration of three years, in graves of four feet depth; or four years, when they are six feet deep. This term affords many varieties, according to the nature of the earth, and the constitution of the subjects buried in it; but we may consider it as a medium. The pernicious custom, which allows a single grave to families more or less numerous, ought therefore to be suppressed; for in this case, the same grave may be opened before the time prescribed. These are abuses which ought to occupy the attention of government; and it is time that the vanity of individuals should be sacrificed to the public safety. It is likewise necessary to prohibit burying in vaults, and even in coffins. In the first case, the principles of the bodies are spread into the air, and infect it; in the second, their decomposition is slower and less perfect.

If these precautions be neglected; if the dead bodies be heaped together in too confined a space; if the earth be not proper to absorb the juices, and decompose them; if the grave be opened before the entire decomposition of the body;—unhappy accidents will no doubt be produced; and these accidents are but too common in great towns, where every wise precaution is neglected. An instance of this happened, when the ground of the church of St. Benoit at Paris was dug up a few years ago: a nauseous vapour was emitted, and several of the neighbours were affected by it. The earth which was taken out of this grave was unctuous, viscid, and emitted an infectious smell. Messrs. Maret and Navier have left us several similar observations. Chaptal's Elem. of Chem. vol. iii.

Putrefaction is one of the instruments in nature by which many great changes are brought about. In the process of vegetable putrefaction, if we throw together any of the tender, green, and succulent parts of recent vegetables, whether acid or alkaline, in a large heap, in the warm open air, and press them down with an additional weight, if their own be inconsiderable; the middle part of the heap will, in a little time, spontaneously conceive a small degree of heat, and pass successively through the other degrees, till it arrive at a state of ebullition, and be perfectly putrefied.

In the space of three days, from the first putting them together, they will yield a heat, perceivable by the hand, equal to that of a human body in a healthy state; by the fifth, the heat will be too great for the hand to bear without pain; and, lastly, by the sixth, seventh, or eighth day, the juices will generally appear ready to boil; and sometimes the matter will even flame, and burn away.

By this spontaneous operation, the vegetable acquires an abominably putrid, stercoraceous, or cadaverous, taste and odour; and turns entirely into one soft, simular, pulpy mass, or crassamentum, greatly resembling fetid human excrements in the scent, and putrefied flesh in the taste.

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If now this foetid matter, thus obtained, be directly, whilst it remains in its foetid state, committed to a glass retort, and distilled with proper degrees of fire, there will come over, 1. A water impregnated with an urinous spirit, perfectly like that obtainable from animal subjects, and separable by a fresh distillation slowly made in a tall glass, into elementary water, and a large quantity of pure, white, volatile, dry, alkaline salt, not to be distinguished from animal salts. 2. A volatile, alkaline, oily salt, that shoots into globes. 3. An exceedingly volatile and thick foetid oil, both which are entirely like those of animals. And, lastly, the remainder, being calcined in an open fire, affords not the least particle of fixed salt; just as if the subject had really been of the animal, and not of the vegetable kingdom.

This process is truly universal, and holds equally in all kinds of vegetables, though ever so different in their nature and virtue.

Experiments have been made in the coldest and most succulent, or watery, plants; such as purslane, sorrel, &c. as well as with the hottest or most acrimonious, such as the spurge, &c. and it was always found to succeed; but that the sooner, as the vegetable employed contained the greater quantity of oil; though with the same phenomena.

It will likewise succeed with dry vegetables, provided they be moistened with water before they are thrown into heaps; and thus we sometimes see, that stacks of hay will spontaneously take fire, and burn away; especially if the hay was not well dried in the making.

The conditions necessary for the putrefaction of vegetables are similar to those required in the putrefaction of animal substances. It is necessary that the organization be impregnated with water; the contact of air is necessary, as is also a certain degree of heat; and for the due effect of this kind of decomposition, the vegetables should be heaped together, and their juices be abundant. In these circumstances, the phenomena of decomposition are as follow: the colour of the vegetable is changed; the green leaves become yellow, the texture becomes lax, and the parts less coherent; the colour of the vegetable itself changes to black or brown; the mass rises, and perceptibly swells up; the heat becomes more intense, and is perceived on approaching the heap; and the fumes which arise have already a smell, which sometimes is not disagreeable; at the same time bubbles arise, and break at the surface of the liquid, when the vegetables are reduced to a magma. This gas is a mixture of nitroge, hydrogen, and carbonic acid. At this epocha, likewise, an ammoniacal gas is emitted, which is formed in these circumstances: and, in proportion as these appearances diminish, the strong and offensive odour is succeeded by another which is fainter and milder, and the mass becomes dry. The internal part still exhibits the vegetable structure, when the item is solid, and the fibrous matter has been the predominating principle; and it then constitutes manure or soil. Hence it arises that the herbaceous plants of a loose texture, and abounding in juices, are not capable of forming manure by their decomposition, but are reduced into a brown mass of little consistence, in which neither fibre nor texture are observed; and this is what, for the most part, forms vegetable mould.

Vegetable mould usually constitutes the first covering or stratum of our globe; and in such cases wherein it is discovered at a depth in the earth, there is no doubt but it has been buried by some revolution.

When a vegetable is converted into earth by this tumultuous fermentation, it still retains the remains of the vegetable, mixed and confounded with the other solid earths

and metallic products; and by distillation it affords oil, nitroge gas, and often hydrogen. It may, therefore, be considered as an intermediate substance between crude and organic bodies, which participates of the inertia of the one, and the activity of the other; and which in this state is still subject to an insensible fermentation, that changes its nature still more, and deprives it of all its organic contents. These remains of vegetables, still contained in vegetable earth, serve as food for other plants that may grow in it. The insensible progress of fermentation, and the suction of vegetables, impoverish the vegetable earth, deprive it of all its organic matter, and there remain only the earths and metallic residue which form the stiff poor soils, and ochres when the ferruginous principle is very abundant.

As this muddy earth is a mixture of all the primitive earths, and some of the metals which are the product of vegetation, as well as the oils, the salts, and other products we meet with in it; we may consider it as the residue of vegetable decomposition, as the great agent and means by which nature repairs the continual losses the mineral kingdom undergoes. In this mixture of all the principles the materials of all compounds exist; and these materials are so much the more disposed to enter into combinations, as they are in a more divided and disengaged state. It is in these earths that we find diamonds, quartz-crystals, spars, gypsum, &c. It is in this matrix that the bog ores, or ochreous ores of iron, are formed; and it appears that nature has reserved the impoverished residue of vegetables for the reproduction or reparation of the earthy and metallic substances of the globe, while the organic remains are made to serve as nourishment for the growth of other succeeding vegetables.

Some have taken occasion to apply the process of putrefaction to that of digestion, or the change which the aliment suffers in the human body. (See DIGESTION.) For the change our vegetable foods undergo in the body, being such as brings them to be of the same nature, and to afford the same principles, with the change induced by putrefaction, is a presumption, that digestion is nothing else. Besides, as we know that neither animal nor vegetable substances can become aliment, without undergoing some degree of putrefaction, many distempers must proceed from a deficiency of this action: the crisis of fevers seems to depend upon it; and even animal heat, according to Dr. Stevenson, does the same.

Now, that the concoction of the humours is nothing else but putrefaction, seems probable from hence, that whenever they are in that state, they are always more fluid, and fitter to pass through the smaller vessels, where they stagnated before. Again, the offensiveness of the sweats, or other excretions consequent on a crisis, is likewise a sure sign of a high degree of corruption. The time of resolution or putrefaction depends on the degree of heat, the habit of the patient, and on the part obstructed. Resolution is the putrefaction of the impacted humour only, but suppuration implies a corruption of the vessels also. This manner of speaking, indeed, has been disused, from the prejudice that nothing was putrid but what was offensively so; whereas, in fact, every fibre becoming more tender, and humour thinner, may be considered as putrid in some degree, whether the change tends to the better health, or to the destruction of the person, or whether it becomes grateful or offensive to the senses.

Mr. Boyle has used the words *fermentation* and *putrefaction* of the blood promiscuously, in his Treatise on the Human Blood. Stahl and other celebrated chemists likewise use the term *putrid ferment*; which see.

PUTREFACTION.

It is, therefore, justly observed by lord Bacon (Nat. Hist. cent. iv.) that an enquiry into the means of preventing or staying putrefaction is of excellent use in physic. Sir John Pringle has made many curious experiments with a view of determining the power of certain substances to promote or to prevent putrefaction, together with remarks on this subject, which are published in the *Phil. Trans.* vol. xlv. p. 480. 525. 550, and by way of appendix to his *Observations on the Diseases of the Army*. From the experiments of this learned and judicious physician, it appears, that salts of every kind, whether acid, alkaline, or neutral, fixed or volatile, as well as the astringent and gummy-resinous part of vegetables, all of them resist and most of them correct putrefaction; and he pursued this branch of enquiry so far as to enable him to form a table shewing the comparative antiseptic power of the several substances, that of sea-salt being the standard. See this table under the article *ANTISEPTIC*.

Of all resinous substances, he found that camphor resisted putrefaction most powerfully; its antiseptic power being three hundred times greater than that of sea-salt. Decoctions of wheat, barley, and other farinaceous grains, checked putrefaction, by becoming sour. He also made experiments to discover the effects of mixing vegetable with animal matters.

Two drams of raw beef, as much bread, and an ounce of water, being beat to the consistence of pap, and exposed to 90° of heat, according to Fahrenheit's thermometer, began to ferment in a few hours, and continued in a fermentation two days. When it began to ferment and swell, the putrefaction had begun; and in a few hours afterwards the smell was offensive. Next day the putrid smell ceased, and an acid taste and smell succeeded. Fresh alimentary vegetables, as spinach, asparagus, scurvy-grass, produced similar effects as bread on flesh, but in a weaker degree. From several other experiments, he found that animal substances excite the fermentation of vegetable substances; and that the latter substances correct the putrescency of the former.

By adding saliva to a similar mixture of flesh, bread, and water, the fermentation was retarded, moderated, but rendered of twice the usual duration, and the acid produced at last was weaker than when no saliva was used.

By adding an oily substance to the common mixture of flesh, bread, and water, a stronger fermentation was produced, which could not be moderated by the quantity of saliva used in the former experiment, till some fixed alkaline salt was added, which salt was found, without saliva, to stop suddenly very high fermentations.

He did not find that small quantities of the following salts, sal ammoniac, nitre, vitriolated tartar, sal diureticus, salt of hartshorn, salt of wormwood, were septic, as small quantities of sea-salt were.

Sugar was found to resist putrefaction at first, as other salts do, and also to check the putrefaction after it had begun by its own fermentative quality, like bread and other fermentative vegetables.

Lime-water made some small resistance to putrefaction.

Port-wine, small beer, infusions of bitter vegetables, of bark, and the juice of antiscorbutic plants, retarded the fermentation of mixtures of flesh and bread. But an unstrained decoction of bark considerably increased that fermentation.

Lime-water neither retarded nor hastened the fermentation of such a mixture; but when the fermentation ceased, the liquor was neither putrid nor acid, but smelt agreeably.

Flesh pounded in a mortar was found to ferment sooner than that which had not been bruised.

The tough inflammatory crust of blood was found to be

most putrescent, next to which the crassamentum, or red coagulated mass, and lastly the serum.

Charcoal is a powerful antiseptic: hence all sorts of glass-vessels and other utensils may be purified from long retained smells of every kind, in the easiest and most perfect manner, by rinsing them out well with charcoal powder, after the grosser impurities have been scoured off with sand and potash. Rubbing the teeth and washing out the mouth with fine charcoal powder will render the teeth beautifully white, and the breath perfectly sweet, when an offensive breath has been owing to a scorbutic disposition of the gums. (*Crell's Journal*, vol. ii.) Meat also, which is a little tainted with putridity, may at once be made sweet by charcoal; and it has been said, that common raw spirits agitated with charcoal will be deprived of their bad flavour, but they are apt to resume their old flavour, if kept in the cask only a few weeks.

The experiments of the author of the "*Essai pour servir à l'Histoire de la Putrefaction*," shew that metallic salts, resinous powders, extracts of bark and opium, are very powerfully antiseptic, and that salts with earthy bases are less antiseptic than any other salts.

The same ingenious physician made some attempts towards the sweetening of corrupted flesh by means of mild substances. For this purpose he put a piece of putrid flesh into an infusion of chamomile flowers, which was renewed twice or thrice in as many days, and its sweetness and firm texture were recovered. Several pieces of putrid flesh were also sweetened by repeated affusions of a strong decoction of the bark; and he constantly observed, that not only the corrupted smell was removed, but a firmness restored to the fibres. The corrupt yolk of an egg, diluted with water, was sweetened by mixing it with a strong infusion of chamomile flowers. He found also that decoctions of wormwood, of the bark, and infusions of chamomile flowers, and of snake-root, preserved yolks of eggs for a longer time than water, even with the addition of a considerable quantity of sea-salt; and that they were preserved better by salt of hartshorn than by four times the weight of sea-salt. Ox-gall was kept for some time from putrefaction by small quantities of ley of tartar, spirit of hartshorn, crude sal ammoniac, and the saline mixture; and still longer by a decoction of wormwood, infusion of chamomile flowers and of snake-root, and by solutions of myrrh, camphor, and salt of amber. The serum of human blood was preserved by a decoction of the bark, and an infusion of snake-root, as effectually as flesh. See *ANTISEPTIC*.

For an account of sir John Pringle's experiments and observations with respect to those subjects that hasten or promote putrefaction, see *SEPTICS*.

Dr. Macbride's experiments confirm many of those above related, especially those which shew that the fermentation of vegetable substances is increased by a mixture of animal or putrescent matter, that the putrescency of the latter is corrected by the fermentative quality of the former; and that the putrefaction and fermentation of mixtures of animal and vegetable substances were accelerated by additions of absorbent earths and of Peruvian bark. He also found, that although unburnt calcareous earths were septic, quicklime and lime-water prevented putrefaction, but that they destroyed or dissolved the texture of flesh.

From his experiments we learn also, that acids, even when greatly lowered, have a strong degree of power to resist putrefaction, and also to correct it; but that they destroy the texture of the substance whose soundness they were supposed to restore; that salts in general, by a property which is common to them all as salts, have the same power,

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power, but that they exceed the acids in their efficacy for correcting putrefaction; that fermenting and effervescent mixtures are the most powerful of all known antiseptics; and, in general, that whatsoever hath a power to restrain the escape of the fixed air, or hinder the intestine motion, must of course prevent putrefaction; and that fixed air, when transferred from a sound body to one that is putrid, appears to restore to that body the principle which has been destroyed or lost.

Dr. Macbride objects against the administration of acids in putrid diseases, for the following reasons; because, if they came unchanged to the absorbent vessels, they would not admit of them, and if they did, they would be dangerous, and they are quite changed before they leave the *primæ viæ*. Dr. Crell (*Phil. Trans.* vol. lxi. part i. p. 340.) has replied to this reasoning, and proposed experiments to prove, that acids, though changed in the alimentary canal so far as not to effervesce with alkalis, may, notwithstanding, check putrefaction, and, therefore, that their use is of great consequence, and ought not to be omitted in putrid diseases.

With regard to the exhibition of alkalis, Dr. Macbride observes, that the point is not yet satisfactorily settled. There can be no doubt of their power to resist and correct putrefaction in dead bodies; but whether, upon the presumption of this virtue, they can be given with propriety as antiseptics, he adds, is not so clear. Dr. Crell affirms, that they can never be used in living bodies as antiseptics; for, laying aside their stimulating quality, which must prevent their use in most of the putrid diseases, they would, he apprehends, increase the morbid matter, by being intimately mixed by circulation with phlogistic matter, which they find abundantly in such bodies. Altringents, says Dr. Macbride, prevent putrefaction very powerfully, but they have not the least degree of efficacy in correcting it; and as antiseptics, they can be of importance only in those cases where, from extreme relaxation and resolution of the solids, the dissolved fluids are suffered to transude, and either form spots of different hues, or run off by actual hæmorrhage; and he apprehends, that acids act in those cases where they have been administered with success, merely as altringents. The antiseptic virtue of the gummy-resinous vegetables, judging of their effect by that of the bark, appears to depend on their fermenting in the body, and parting with fixed air in the course of their fermentation, and throwing a great quantity of it into the blood; and attending to the things that prevent putrefaction in living bodies, we shall find that the dependence is on the quantity of air. Thus, vegetable food prevents the putrefactive diathesis; and to the frequent use of fresh vegetables and sugar, in the diet of the European nations, it is owing that putrid diseases or plagues are now so uncommon. And what proves almost to a demonstration the antiseptic power of the fermentable substances, is the cure of the sea-scurvy.

Dr. Crell disagrees with the opinion of Dr. Macbride, that putrid diseases may be cured with fermentable substances only; nor is he convinced that putrefaction depends only on the loss of fixed air. This, he apprehends, is an effect rather than the cause of putrefaction. We shall here only add, that Dr. Macbride recommends, in the putrid yellow fever of the West Indies, to give the patient repeated doses of the alkaline salts, in fresh lime-juice, or the like, and to let it be swallowed during the effervescence; and to order the patient's drink to be somewhat of the highly fermentable kind; such as the juice of the green sugar-cane, diluted and acidulated with some of the recent four juices. The natives on the coast of Africa give in fevers of this kind, with good

success, a drink prepared by macerating in water a fruit of the plum kind, that grows there in great plenty. He adds, that by throwing in such a quantity of antiseptic vapour as would be furnished from this kind of materials, the putrefactive acrimony, which at first seems chiefly to affect the biliary system, might be corrected and saturated. See on the subject of this article Dr. Macbride's *Essays*, 1776, passim.

PUTREFACTION, in *Physiology*, the spontaneous changes which animal substances undergo, when deprived of life. See DEATH.

PUTREFACTION, in *Agriculture*. It is by means of putrefaction, as stated under its appropriate article, that various substances and bodies are decomposed, reduced, and brought into the state proper for being applied to lands for the support of crops; but this is more fully explained, in speaking of the nature of the different materials that are capable of being made use of in ameliorating land for the growth of crops. See MANURE.

PUTREFACTION of *Water*. It is said to be the peculiar quality of the Thames water, that it will stink and yet be wholesome; and after this will recover itself again. Many sailors have been obliged to drink it stinking, so that they held their noses while they poured it down their throats, yet no sickness ensued from it. It generates a sort of spirit also in this stinking state, which will take fire at the approach of a lighted candle, as if spirit of wine were touched by the flame.

It appears from the article PUTREFACTION, that though a volatile alkali may be obtained from putrid substances by distillation, such substances must not be suffered to remain too long before they are distilled, unless they are kept in close vessels; because the volatile alkali, which is the offspring of putrefaction, is dissipated as fast as it is generated, inasmuch that, at length, nothing is left behind but an insipid water, or a solid matter, being an earth similar to common mould. It is in this way, says Dr. Macbride, that stinking water, after some time, becomes sweet: the volatile alkali, generated by the putrefaction of the animal and vegetable substances at first contained in the water, being, after a while, entirely dissipated, leaves the remainder without any disagreeable smell.

Putrid water is immediately deprived of its offensive smell by charcoal. If putrid water be agitated with a small quantity of magnesia, it will lose its bad taste and smell in a few minutes. See Crell's *Journal*, and Proust, *Journal de Physique*.

A method of preserving water free from putrefaction was some years since proposed by Dr. Alston. It consisted in adding a quantity of lime to every cask of water; and as lime is known to have a strong antiseptic property, water, as long as it retains the impregnation of lime, never putrefies.

In order to free the water, at the time of using it, from the lime, Dr. Alston proposes the precipitation of the latter by throwing a quantity of magnesia alba, on this principle, that as lime-stone is rendered soluble in water by the deprivation of its fixed air, and has a greater affinity with that air than magnesia has, the particles of quicklime dissolved in the water would attract the air from the magnesia, and thereby becoming no longer soluble, would fall to the bottom, and leave the water tasteless and fit for economical uses. See LIME-water and MAGNESIA.

The expence, however, attending this process prevented the execution of the proposal. Mr. Henry has not long ago suggested a cheap and easily practicable method of precipitating the lime, and thus of restoring the water to its original taste. The following is a short sketch of the author's process. To

preserve the water from putrefaction, two pounds of good quicklime are directed to be added to each cask of water of a hundred and twenty gallons. To free the water afterwards from the lime with which it has been impregnated, it is to be drawn off into a strong cask, containing about sixty gallons, with an aperture at one end large enough to admit a vessel, which is to be let down into it by means of strings, and which contains a proper quantity of effervescent materials, that is, of marble or chalk, and vitriolic acid. Eight ounces of mild calcareous earth, and six ounces of strong vitriolic acid, will be sufficient for sixty gallons of lime-water. The mouth of this last vessel is to be stopped with a tubulated stopper, through which the fixed air, let loose from the marble, passes up through the body of the water. The lime is thus rendered insoluble, and is soon precipitated in the form of an impalpable powder of chalk; the water being thus restored to the same state of purity as when it was first shipped on board; or, as Mr. Henry believes, to a state of still greater purity; several hard waters having, in consequence of this process, been rendered as soft as rain water, and freed from different impregnation. For farther particulars, and the description and drawing of an apparatus for this operation, see Henry's Account of a Method of preserving Water at Sea, &c. p. 10, &c. 1781.

PUTRESCENT MATTERS, in *Agriculture*, such substances as are in a state of putridity. Various materials of this kind are capable of being made use of by the farmer. It has been lately suggested by Dr. Hunter, of York, in a paper in the third volume of the Farmer's Magazine, that different materials of this nature may form a substitute for the folding of sheep.

The trouble and expence of keeping a flock of sheep for the purpose of folding, may probably be avoided by forming large ponds, so constructed as to receive and hold water. Into these ponds let drains from the stables, cow-houses, ox-stalls, pigeon and wash-houses be directed; and, in order to enrich the water, let all kinds of vegetable and animal substances be thrown in, particularly the contents of the necessaries and slaughter-house. It is presumed, that this putrid water, when put upon the land by means of water-carts, will prove as beneficial as a flock of sheep kept for the express purpose of folding; and where no sheep are kept for that purpose, such will prove an excellent manure for meadow land. A pond of sixty feet diameter, by six feet deep, which will contain upwards of 700 hogheads of water and putrescent bodies, may be equal in its effects to a considerable fold of sheep. The putrescency of the water may be greatly increased, by occasionally supplying the ponds with the refuse of fish, and sea-weed, where they can be conveniently procured; and in all places within a reasonable distance of sea-ports, where ships are employed in the Greenland fishery, the farmer will find a seasonable supply of putrescent matter by the purchase of the whale blubber, after the oil has been taken from it. Such is the strength of the last named substance, that it is well worth the farmer's while to be at the expence of carrying it in casks to a considerable distance, for the purpose of giving vigour to his compost dung-hills. The ancients were scrupulously nice in the formation of their dung-hills; and it is a reproach to the present race of farmers, that so material a branch of their business should, at this day, be so imperfectly known or attended to. And in many large cities, and especially Edinburgh, it would be a great improvement, if a well-constructed reservoir was made to receive the excrementitious matter, the basin being occasionally replenished with earth and small rubbish. In this manner, many thousands of loads of rich manure might be saved

from the sea, to which place the excrementitious matters are upon their passage.

PUTRID, **PUTRIDUS**, something rotten, or putresced. See **PUTREFACTION**.

Thus we say, putrid flesh; a putrid humour: putrid limbs, *i. e.* mortified ones, are to be cut off.

PUTRID Diseases. See **PUTRID Fever**, &c.

PUTRID Ferment. See **FERMENT**.

PUTRID Fever, &c. in *Medicine*, an epithet originating in the chemical school of physic, in which the true operations and phenomena of *life* were mistaken for the fermentations and decompositions of the laboratory. This mistake was probably the result of the offensive smell, and actual putrefactive odour of some of the discharges from the living body, in the last stages of severe fevers; but farther observation has demonstrated that, however the excretions may undergo the process of putrefaction after they are thrown out of the living system, no degree of putrefaction can exist for a moment in the circulating blood, without occasioning instant death.

The symptoms which were formerly ascribed to putrefaction, but which are now believed to originate from a great deficiency of the vital or nervous power derived from the brain and nervous system, are such as occur in typhus gravior, the hospital and gaol fever, and in the worst cases of dysentery, and small-pox; among which are a black tongue and mouth, extreme prostration of strength, fœtid evacuations from the stomach, bowels, and bladder, hæmorrhages, petechiæ, and purple blotches, &c. See **FEVER**, and **TYPHUS**.

PUTRID Ulcer. See **ULCER**.

PUTRINE, in *Geography*, a town of Prussia, in Oberland; six miles W. of Passenheim.

PUTT, in *Rural Economy*, a provincial word, applied commonly in some districts to the mole-hill. Also, sometimes to animals which put or thrull with their horns.

PUTT, or *Pitne*, in *Geography*, a town of Anterior Pomerania; eight miles S.W. of Stralsund.

PUTTAN-SUMNAUT, a town of Hindoostan, in Guzerat; near which was a famous pagoda, much venerated and frequented by devotees from all parts of the country. In the year 1002 this town and temple were taken by Mahmood, king of Ghizni, and plundered of their great wealth. In the temple was found a statue, in which, on being broken, was found a vast quantity of precious stones. The Hindoos believed that the souls of deceased persons came to this place to be transferred to other bodies; 80 miles S. of Noanagur. N. lat. 21° 1'. E. long. 69° 40'.

PUTTEN, **VANDER**, **HENRY**, in *Biography*, was born at Vandloo in 1574: after studying at the universities of the Low Countries, he visited Italy, and for a considerable time was professor of rhetoric at Milan, where he took the degree of doctor of laws. He was nominated historiographer to his Catholic majesty, and received the honour of citizenship at Rome. In 1606 he was invited to the chair of Lipsius, who had been his tutor. He was also made a counsellor to the archduke Albert, and entrusted with the government of the citadel of Louvain. When a truce was negotiating between the Dutch and the king of Spain, in 1633, he published a work, entitled "*Statera Belli et Pacis*," in which he shewed how important a peace would be to the Spanish Netherlands. This work gave great offence, and the author had nearly experienced the usual fate of those who counsel pacific measures, at a time when passion, prejudice, and interest, urge the continuance of war. He died at Louvain in 1646, age 72. Besides his "*Statera*," mentioned above, he published "*Historia Infubrica*,"

"*Orchestra*"

"Orchestra Burgundica;" "Theatrum Historicum Imperatorum;" "Comus, seu de Luxu;" "De usu Bibliothecæ," with a catalogue of the Ambrosian library; besides several tracts relative to classical antiquities, printed among the collections of Grævius and Gronovius. Moreri. Bayle.

PUTTEN, in *Geography*, a small island of Holland, in the Meuse, E. of Voorn.

PUTTERAHEE, a town of Hindoostan, in the circar of Gohud; 27 miles E.N.E. of Gohud.

PUTTOCKS, or PUTTOCK-Shrouds, otherwise called *puttock* or *foot-hook shrouds*, in a *Ship*, are small shrouds which go from the shrouds of the main-mast, fore-mast, and mizen-mast, to the top-mast shrouds; and if there be any top-gallant mast, there are puttocks to go from the top-mast shrouds into these. These puttocks are at the bottom seized to a staff, or to some rope which is seized to a plate of iron, or to a dead-man's eye, to which the laniards of the fore-mast shrouds come. See SHROUDS.

PUTTY sometimes denotes a white powder of lead and tin calcined together, in the proportion of two parts of lead to one of tin; used in polishing, and giving the last gloss to works of iron, steel, stone, and glass. This is also the basis of white enamels, and glazings for earthen-ware.

PUTTY is also used to denote spodium.

PUTTY, in its popular sense, denotes a kind of paste, compounded of whiting, with or without a little white lead, and linseed oil, beaten together to the consistence of a tough dough; used by glaziers for fastening the squares of glass in fash-windows, &c. and by painters, to stop up the crevices and clefts in timber and wainscot, to prevent the wet from getting in, and ruining the work.

PUTTYRAM, in *Geography*, a town of Hindoostan, in Bengal; 18 miles E.S.E. of Dinagepour.

PUTUAY, a small island on the coast of Bengal. N. lat. 22° 41'. E. long. 89° 28'.

PUTUMAYO, a river of South America, which rises about 80 miles S. of Popayan, pursues an eastern course, inclining to the south, about 300 miles, and after being joined by a branch of the Caquet, takes the name of Ica, and running S.E. about 200 miles, joins the river of the Amazons in S. lat. 3° 30'. W. long. 50° 40'.—Also, a town of South America, in the government of Popayan, on a river of the same name; 50 miles E. of Palto.

PUTURA, a custom claimed by the keepers of forests, and sometimes by bailiffs of hundreds, to take man's meat, horse's meat, and dog's meat, of the tenants and inhabitants, gratis, within the perambulation of the forest, hundred, &c.

"Johannes clamavit unam puturam in prioratu de Penevotham, qui est quedam cella abbatiæ de Evelham, pro se & ministris, equis, & garrionibus suis, per unum diem & duas noctes, de tribus septimanis, in tres septimanas, viz. de victualibus, ut & esculentis & potulentis, ad collas prioratus prædicti indebite." Placit. apud Præston. 17 Edw. III.

This custom, within the liberty of Knareburg, was long since turned into the payment of four-pence, *pro putura*.

The land subject to this service is called *terra puturata*. The learned Somner has erred in his exposition of this word.

PUTYAJURY, in *Geography*, a town of Bengal; 30 miles S.S.W. of Silhet.

PUTZIG. See PAUZK.

PUVIGLIO, a town of the duchy of Parma; nine miles N.E. of Parma.

PUWAKHAGA, in *Botany*, the name by which some

authors call the fausel-tree, of whose fruit the expressed juice called *terra Japonica*, or Japan earth, is made.

PUXUANAIRO, in *Geography*, a town of Mexico, in the province of Mechoacan; 25 miles N.W. of Mechoacan.

PUY, PETER DU, in *Biography*, the third son of Claude du Puy, a magistrate in the parliament of Paris, was born in that city in 1582, and was educated with great care under his father. While a youth, he made extraordinary proficiency in literature, and still further improved himself by a journey to Holland, whither he accompanied the French ambassador. After his return he laboured with great assiduity in ascertaining the rights of the crown of France over some of the neighbouring districts, and for that purpose was indefatigable in his examination of ancient charters, and thereby acquired a profound knowledge of French history. The reward of this, and other labours of the same sort, were the places of king's counsellor, and keeper of the royal library, in both of which he was distinguished by his patriotism and love of letters. His works were numerous and valuable. In almost all of them he aims at repressing the ecclesiastical authority, and the claims of the see of Rome; hence they were not well received at the papal court. They are, however, said to contain a rich treasure of facts relative to all the matters on which he treats. He died at Paris in 1651, at the age of 69, and his life was written by his intimate friend Nicholas Rigault. Some of his writings are as follow: "Preuves des Libertés de l'Eglise Gallicane;" "Histoire Vritable de la Condemnation de l'Ordre des Templiers;" "Traité de la Loi Salique;" "Du Concordat de Bologne entre le Pape Léon X., et le Roi Francis I.;" "Apologie de l'Histoire de M. le Président de Thou." He had a brother, James, prior of St. Sauveur, who became keeper of the king's library after the death of Peter, whom he assisted in all his works, of the greater part of which he was the publisher. He died in 1656, leaving behind him a high character for learning and probity. Another brother, Christopher du Puy, was prothonotary to the cardinal de Joyeuse, and by his remonstrances he prevented the congregation of the Index from putting the first of De Thou's history in the list of heretical books. He was king's almoner, and, while attached to cardinal du Perron, he made a collection entitled "Perroniana." He became a Carthusian, and died at Rome in 1554, proctor-general of his order.

PUY, LOUIS DU, a man of letters, was born at Clarey, in Bugey, in 1709; he studied in the college of Lyons, and came to Paris in 1732. He was for a considerable time principal editor of the *Journal des Sçavans*, and during thirty years enriched this collection with a great number of critical dissertations. He was well versed in the learned languages, and in the mathematics, and acquired an extensive knowledge of history and antiquities. The prince of Soubise entrusted him with the management of his library, and by his care it was rendered one of the most valuable in the metropolis. In 1753 he was nominated secretary to the Academy of Inscriptions, in which situation he pronounced the eulogies of twelve of his associates, and edited from the 36th to the 41st vols. of its memoirs. He died in 1795. He was author of "Observations on infinitely small Quantities, and the metaphysical Principles of Geometry," inserted in the *Journal des Sçavans* for 1759; "A Translation of four Tragedies of Sophocles," 1762; "A Translation of the Greek Fragments of Anthemius on mechanical Paradoxes, with Notes;" some memoirs on the Roman coin, the silver denier of Charlemagne, and other antiquarian and literary subjects. Du Puy was highly esteemed for strict probity,

incerity, and an obliging disposition, which displayed itself in useful advice and information to those who consulted him on literary topics.

Puy, Mademoiselle du, a celebrated performer on the harp, who had acquired a considerable fortune by the exercise of her talents in different parts of Europe. She died at Paris in 1777, and made a will that seemed dictated by insanity. Among other articles, she ordered that no blind, lame, or deformed person should attend her funeral. She ordered that her horse should be let to none but nobility. She left a large piece of ground to be formed into a public garden, upon condition that no stunted trees should be allowed a place in it. And lastly, she bequeathed an annuity for the maintenance of cats, of which she was fond, and for a person to take care of them. But the annuity depended wholly on the life of the cats. The harp upon which she had acquired her possessions, was left to a blind harper in the Hospital des Quinze Vingts, who played tolerably well on many different instruments. Great pains were taken to set this will aside, but without effect. It was declared valid by law, and obliged to be executed. Laborde.

Puy, Le, in *Geography*, a town of France, and principal place of a district, in the department of the Upper Loire, and capital of the department, situated on a small river near the Loire; before the revolution, the see of a bishop; a place of considerable trade, especially in lace; 38 miles S.W. of Lyons. The place contains 15,915 inhabitants, in two cantons, the one containing 13,396, and the other 14,100, on an extent of 185 kilometres, in 16 communes. N. lat. 45° 2'. E. long. 3° 57'.

Puy-Laurens, a town of France, in the department of the Tarn, and chief place of a canton, in the district of Lavaur; 12 miles S.E. of Lavaur. This place contains 5648, and the canton 9817 inhabitants, on a territory of 125 kilometres, in 9 communes.

Puy-l'Evêque, a town of France, in the department of the Lot, and chief place of a canton, in the district of Cahors; 14 miles W. of Cahors. The place contains 2082, and the canton 12,127 inhabitants, on a territory of 285 kilometres, in 11 communes.

Puy-Mirol, a town of France, in the department of the Lot and Garonne, and chief place of a canton, in the district of Agen. The place contains 1263, and the canton 8072 inhabitants, on a territory of 125 kilometres, in 11 communes.

Puy de Belliard, a town of France, in the department of La Vendée; 18 miles N.W. of Fontenay le Comte.

Puy Gasquier, a town of France, in the department of the Gers; nine miles N.E. of Auch.

Puy de Dome, a mountain of France, near Clermont en Ferrand, 810 toises in height.

Puy de Dome is also the name of one of the nine departments of the central region of France, so called from the mountain that is situated in it; it is bounded on the N. by the department of the Allier, on the E. by that of the Rhône and Loire, on the S. by the departments of the Cantal and Upper Loire, and on the W. by those of the Correze and Creuse; formerly Lower Auvergne, in N. lat. 45° 40', containing 8450 kilometres, or about 35 French leagues in length, and 22 in breadth, or 447 square leagues, and 508,444 inhabitants; divided into five districts, viz. Riom, including 126,640; Thiers, 61,530; Ambert, 73,535; Clermont, 158,449; and Issoire, 88,290 inhabitants; 50 cantons, and 438 communes. The circles, according to Haffenfratz, are 8, the cantons 71, and the population 516,593. Its capital is Clermont. The ge-

neral total of its contributions in the 11th year of the new French era, was estimated at 3,656,547 francs; and its expences for administration, judiciary, and for public instruction, at 374,681 francs, 37 cents. The soil of this department, diversified with hills and plains, is remarkably fertile, producing abundantly grain, wine, fruits, hemp, and pastures. It has mines of silver and lead, mineral springs, &c.

Puy le Gardé, a town of France, in the department of the Lot; 15 miles N.E. of Montauban.

Puy Guillaume, a town of France, in the department of the Puy de Dome; eight miles N.E. of Lezoux.

Puy Laurens, a town of France, in the department of the Aude; seven miles S.E. of Quillan.

Puy Maria, a town of France, in the department of the Upper Garonne; 17 miles N. of St. Gaudens.

Puy Miolan, a town of France, in the department of the Lot and Garonne; six miles E. of Marmande.

Puy Moisson, a town of France, in the department of the Lower Alps; 15 miles S. of Digne.

Puy Notre Dame, or **Puy en Anjou**, a town of France, in the department of the Mayne and Loire; 10 miles S.W. of Saumur.

Puy de la Poix, a town of France, in the department of the Puy de Dome; 18 miles E. of Clermont.

Puy la Roque, a town of France, in the department of the Lot; 17 miles N.E. of Montauban.

Puy St. Martin, a town of France, in the department of the Drôme; 11 miles N.E. of Montelimart.

Puy Val d'Or, a town of France, in the department of the Eastern Pyrenées; 10 miles N.W. of Montlouis.

PUYA, in *Botany*, the vulgar name, in Chili, of a plant, which is figured in Feuillée, v. 3. 59. t. 39, and adopted as a genus, after Molina, in Jusieu's Genera 447, under the above barbarous appellation, with the following character.

"Calyx in six deep segments; the three innermost largest, and vaulted. Stamens six, inserted into the lower part of the calyx; their filaments formed like a scale at the base, and bearing honey. Germen superior, triangular; (style and stigma unknown). Capsule of three cells, with numerous minute seeds, (doubtful whether furnished with down.)"

Feuillée's description is to the following effect. The roots are fibrous, throwing up several stems, about nine feet high, as thick as a man's body at the bottom, where they are clothed with the scaly imbricated vestiges of old leaves, above which stand the numerous leaves of the present year. These are three or four feet long, and about two inches wide, resembling the foliage of the Pine-apple, their margins being fringed with very sharp hooked prickles, five lines long, and about an inch and a half asunder; the surface of the leaves is smooth, shining, of a fine bright green. The Indians make use of these prickles as fish-hooks. The part of the stem above the leaves is round, two inches or more in thickness; of a blueish-green externally; white and watery within, clothed with very short, alternate, clasping leaves, or scales. The summit consists of a large pyramid of flowering branches, or spikes, the lowermost a foot long; all clothed with similar scales, or bractæas, each of which is accompanied by a sessile axillary flower. Each flower is composed of six leaves, three large and three small, in a double row. The latter are three quarters of an inch long, (Feuillée says, apparently by mistake, three inches,) and three lines and a half broad, covered with minute white down; the three larger are of a greenish-yellow, two inches and a half long, and nine lines broad, terminating like a Gothic arcade. The flowers roll up spirally as they fade. Six stamens spring from the bottom of each flower, surrounding a triangular pistil, which extends beyond them, and becomes

a fruit of three cells, filled with an infinite number of seeds. Feuillée met with several specimens of this plant in the kingdom of Chili. He refers it to his genus of *Rencalmia*, the *Tillandsia* of Linnæus. Jusliu justly suspects its being the same genus with PHERIPPIER'S PITCAIRNIA, see that article; of which therefore the plant in question may be presumed to constitute an additional species to the four we have described; agreeing molt with *P. bracteata* in habit, size and colour, but differing in having more spinous leaves, as well as a more compound inflorescence.

The reader will observe that Jusliu, according to the principles he had assumed, calls the whole integument of the flower a calyx, while we follow other writers in taking the three inner parts for petals; a measure justified, if we mistake not, by their habit, and mode of withering. The little differences respecting the scales or nectaries may easily be reconciled.

PUYCERDA, in *Geography*, a town of Spain, in Catalonia, and capital of the county of Cerdagne, surrounded with walls and bastions, and defended by a castle; 19 miles E.N.E. of Urgel. N. lat. $42^{\circ} 30'$. E. long. $1^{\circ} 48'$.

PUYO, a town of France, in the department of the Landes; nine miles S.W. of Aire.

PUYS, a term used for the poles with which the keels on the Tyne river are stowed along.

PUYSEGUR, JAMES DE CHASTENET, *Lord of*, in *Bio-graphy*, lieutenant-general under Lewis XIII. and XIV., was born in 1600. He entered the army at the age of seventeen, and served, without intermission, during forty-three years. He was present at above thirty battles, and one hundred and twenty sieges, without ever having been sick or received a wound, but he had not the good fortune to rise in his profession, being more zealous for the king's service, than complaisant to the ministers. He drew up "Memoirs," comprising the period from 1617 to 1658, in which are contained various remarkable particulars relative to the campaigns in which he served, with useful military instructions. They were printed at Paris and Amsterdam in 1690, 2 vols. 12mo. under the inspection of Du Chefne, historiographer of France, and they have the character of narrating with freedom and fidelity. He died at his country seat in 1682. Moreri.

PUYSEGUR, JAMES DE CHATELET, *Marquis de*, was son of the preceding, born at Paris in 1655, and entered into the army under his father, and gradually rose to the post of commander-in-chief in the French Netherlands, and finally, to the still more important one of a marshal of France in 1734. He died at Paris in the year 1743, at the age of 88. He was author of a work "On the Art-Military," published by his only son the marquis of Puysegur. Moreri.

PUZZALO, in *Geography*, a town of the island of Sicily, in the valley of Noto, near the S. coast of the island; 12 miles S.W. of Noto.

PUZZLING BAY, a bay in the straits of Magellan, on the coast of Patagonia. N. lat. $53^{\circ} 35'$. W. long. $74^{\circ} 28'$.

PUZZOLANA. See POZZOLANA, and *Calcareous CEMENT*.

PUZZUOLI, in *Geography*. See POZZUOLI.

PWLLHELI, a borough, market, and sea-port town in the parish of Denio, cwmwd of Cannologion, cantref of Lley, now called the hundred of Gyfflogion, county of Caernarvon, South Wales, is situated on the south side of the promontory of Lley, in St. George's Channel, at the distance of 27 miles S.S.W. from Caernarvon, and $243\frac{1}{2}$ miles W.N.W. from London. This town consists chiefly of a single street, running parallel to the shore. It was constituted a free borough by Edward the Black Prince, at

the request of Nigel de Lohareyn, and had its privileges confirmed by king Edward III. The government is vested in a mayor, recorder, and two bailiffs, who have the powers of justices. The market days here are Wednesday and Saturday, weekly; and there are besides six annual fairs. This port has a considerable trade; and upwards of eighty ships, of different burthens, belong to it. Along the coast to Bardsea island, an extensive and valuable herring fishery has been lately established. The harbour is good, and well sheltered from the winds; and the bay, to which the town gives name, affords excellent anchorage ground. Pwllheli is one of the contributory boroughs with Caernarvon, in returning one member to parliament, and is likewise the seat of the petty sessions for the district of Lley, which extends about twenty-two miles in length, and from three to ten in breadth, projecting into the sea in a manner similar to the county of Cornwall. According to the parliamentary returns of 1811, the parish contains 312 houses, and 1383 inhabitants, of which number, above one-half are resident in the town of Pwllheli.

At the distance of five miles from this town is Carn-Madryn, a strong fortress, which formerly belonged to the sons of Owen Gwynedd. The bottom, sides, and top are filled with cells, varying in size and shape, many of which are still nearly entire. Close to the sea-coast is an entrenchment, called Dinas Dinlle, which constitutes an object of great attraction from the road to Caernarvon by Clynog Fawr, a neat romantic village, boasting one of the largest and handsomest churches in Wales. Near it is the valley called Nant-y-Gwrtheyrn, or the valley of Vortigern, where that prince is said to have concealed himself, to avoid the persecution of his subjects. It is bounded on two sides by stony steps, only productive of heath and stunted gorse, and on a third by a tremendous precipice. The only opening to this secluded spot is towards the sea, "a northern aspect, where chilling winds exert all their fury, and half freeze, during winter, its few inhabitants." Nicholson's Cambrian Traveller's Guide, 1813. Carlisle's Topographical Dictionary of Wales, 1811, 4to.

PYANEPSIA, ΠΥΑΝΕΨΙΑ, in *Antiquity*, a feast celebrated by the Athenians in the month Pyanepsion; which, according to the generality of the critics, corresponded to our September.

Plutarch refers the institution of this feast to Theseus; who, at his arrival from Crete, made a kind of sacrifice to Apollo of all the provisions remaining in his vessel; putting them all into a kettle, boiling them together, and eating them with his six companions; which custom was afterwards continued. The scholiast of Aristophanes says, this was done to acquit himself of a vow he made to Apollo in a tempest.

M. Baudelot writes the word *Puanepsia*, and takes it to be a feast instituted in memory of Theseus's return after killing the Minotaur.

The Greeks vary as to the origin and signification of the word Pyanepsion, whence the feast is denominated. Harpocration calls it *Pæanoptia*; he adds, that others call it *Panoptia*, because then the fruits all appear to the eye. Hesychius writes *Pyanepsia*; and derives it from πύανον, bean, and εψω, coquo; because in this feast the Athenians gathered their beans, and made a kind of broth of them.

PYANEPSION, ΠΥΑΝΕΨΙΩΝ, in the Athenian *Chronology*, a month of thirty days, in which the festival Pyanepsia was celebrated, and called by the Bæotians Damatrius.

PYAPOUR, in *Geography*, a town of Hindoostan, in Bahar; 13 miles E. of Bahar.

PYBOLOWO, a town of Lithuania; 25 miles E. of Minsk.

PYCIELT, in *Botany*, a name given by Hernandez, and some other authors, to a peculiar species of tobacco, distinguished by Mr. Tournefort by the name of *nicotiana major lato et rotundo folio*, the broad roundish-leaved great tobacco.

PYCNANTHEMUM, a name contrived by Michaux, from *πυκνός*, *dense*, and *ανθος*, *a flower*, to express the dense inflorescence.—Michaux *Boreali-Amer.* v. 2. 7. Ait. Hort. Kew. v. 3. 376. Pursh v. 2. 409. (*Brachystemum*; Michaux *Boreali-Amer.* v. 2. 5.)—Class and order, *Didymia Gymnospermia*. Nat. Ord. *Verticillata*, Linn. *Labiata*, Juss.

Gen. Ch. *Cal.* Perianth of one leaf, inferior, tubular, striated, erect, permanent, with five awl-shaped, acute, nearly equal teeth; the mouth naked. *Cor.* of one petal, ringent; tube cylindrical, the length of the calyx; upper lip nearly erect, oblong, slightly convex, rounded, scarcely notched; lower lip much the largest, widely spreading, channelled, three-lobed; the lateral lobes semi-elliptical; the middle one longest. *Stam.* Filaments four, awl-shaped, distant, various in length; two of them shorter than the rest; anthers with two parallel cells. *Pist.* Germen superior, four-cleft; style bristle-shaped, rather shorter than the corolla; stigmas two, spreading, acute. *Peric.* none, except the permanent calyx. *Seeds* four, roundish.

Ess. Ch. Calyx five-cleft. Middle segment of the lower lip of the corolla longer than the rest. Stamens distant. Anthers with parallel cells.

Obs. This genus seems to differ from *Satureja* principally in the form of its corolla. The species, as far as we know, are all American.

SECT. 1. *Stamens prominent.* *Pycnanthemum* of Michaux.

1. *P. incanum*. Hoary Tufted Savory. Michaux v. 2. 7. Pursh n. 1. Ait. n. 1. (*Clinopodium incanum*; Linn. Sp. Pl. 822. Willd. Sp. Pl. v. 3. 132. *C. menthae folio*, *incanum et odoratum*; Dill. Elth. 87. t. 74. *C. Serpentaria dictum*, &c.; Pluk. Mant. 51. t. 344. f. 1.)—Leaves oblong-ovate, acute, slightly serrated, downy. Heads compound; the lateral ones stalked. Bractæas setaceous.—Found in low fields and copses, from Virginia to Carolina; flowering from July to October. It was cultivated in Sheppard's garden at Eltham before the year 1732, but has scarcely been attended to by recent amateurs. The root is perennial. Stem three feet high, erect, somewhat branched, leafy, bluntly quadrangular. Leaves about two inches long, on short stalks; their under side most hoary or downy. Flowers white, tinged with red, in dense stalked hoary whorls, with a terminal head; their inner bractæas bristle-shaped. The whole herb is clothed with fine soft pubescence; the leaves marked with pellucid dots; their scent aromatic, partaking of the common, as well as sweet, Marjoram.

2. *P. arifolium*. Bristly Tufted Savory. Michaux v. 2. 8. t. 33. Pursh n. 2. Ait. n. 2. (*Nepeta virginica*; Linn. Sp. Pl. 799. Willd. Sp. Pl. v. 3. 56. *Clinopodium amaracifolium*, flore albo; Pluk. Phyt. t. 85. f. 2.)—Leaves ovate-lanceolate, somewhat hoary, slightly serrated. Heads sessile. Bractæas and calyx awned.—Native of dry woods, on a limestone soil, from Maryland to Carolina, flowering in July and August. Miller appears to have cultivated this species in 1752. It is perennial, with altogether the herbaceous aspect of an *Origanum*. The leaves are not an inch long, nearly sessile, dotted, veiny, thick-edged, very minutely, and scarcely perceptibly, hoary. Flowers white, small, in numerous, dense, terminal, hoary, compound heads. Bractæas lanceolate, entire, with long, rigid, awn-like points.

3. *P. montanum*. Mountain Tufted Savory. Michaux v. 2. 8. Pursh n. 3.—“Leaves oval-lanceolate, serrated. Head sessile. Calyxes crowded, erect, with short teeth.”—Native of high mountains in Carolina, according to Michaux, the only person who appears to have gathered this plant. The stem, and part of the rest of the herb, are usually tinged with purple. We have seen neither specimen nor figure.

4. *P. Monardella*. Monarda Tufted Savory. Michaux v. 2. 8. t. 34. Pursh n. 4. (*Origanum incanum*; Walter Carolin. 165.)—Somewhat hairy. Leaves ovate, taper-pointed, serrated. Outer bractæas ovate, coloured, longer than the flowers; inner lanceolate, fringed. Calyx bearded.—Found on the mountains of Virginia and Carolina, but as yet a stranger to our gardens. It flowers from June to August, and is perennial. The habit of the plant, and its coloured bractæas, resemble *Monarda fistulosa*. The flowers are small, and pale red, according to Mr. Pursh, on whom we depend for the synonym of Walter.

5. *P. linifolium*. Flax-leaved Tufted Savory. Pursh n. 5. Ait. n. 3. (*Brachystemum virginicum*; Michaux v. 2. 6. *B. linifolium*; Willd. Enum. 623. *Thymus virginicus*; Linn. Syst. Veg. ed. 13. 453. Willd. Sp. Pl. v. 3. 145. *Satureja virginiana*; Linn. Sp. Pl. 793. Herm. Parad. 218. t. 218. *Pulegium virginianum angustifolium*, &c.; Pluk. Phyt. t. 54. f. 2.)—Stem erect, much branched, corymbose, roughish. Leaves lanceolate, entire. Heads crowded, nearly globular. Bractæas ovate, fringed.—Found in rather dry and mountainous meadows of North America, from New England to Carolina, flowering in July and August. Miller had it in cultivation in the year 1739, and it is still preserved in curious gardens, being a tolerably hardy, somewhat shrubby, perennial, of a bushy corymbose habit, about eighteen inches or two feet high. The whole plant smells strongly of Penny-royal. The stem is square, pale, downy chiefly at the angles; its upper branches rising all nearly to a level, and forming a corymbus of numerous, globose or hemispherical, downy heads, of small white flowers. The bractæas are numerous, all ovate; the outer ones large, the inner very downy. Such is the plant intended by Linnæus under the above synonyms, and which is perhaps rather the *P. lanceolatum* of Pursh, than his *linifolium*. In the latter the *stamens* are longer than the *corolla*; in the former they are shorter; but this is evidently, as in Mints, a variable circumstance; and therefore the *Pycnanthemum* and *Brachystemum* of Michaux, are certainly one and the same genus. We are confident also that there is no specific difference between Pursh's and Willdenow's *linifolium* and *lanceolatum*.

SECT. 2. *Stamens within the tube.* *Brachystemum* of Michaux.

6. *P. muticum*. Pointless Tufted Savory. Pursh n. 7. (*Brachystemum muticum*; Michaux v. 2. 6. t. 32.)—Leaves ovate, pointed, smoothish, somewhat serrated. Heads terminal, sessile, solitary. Bractæas lanceolate, acute, awnless.—Gathered by Michaux in Upper Carolina. Mr. Pursh never found this species. The former writer is incorrect in his definition of the leaves, which are by no means “lanceolate-oval,” nor are they “dentate,” but truly serrated, at least in his plate. The heads bear some resemblance to those of our fifth species, but are less globose.

7. *P. verticillatum*. Whorled Tufted Savory. Pursh n. 8. (*Brachystemum verticillatum*; Michaux v. 2. 6. t. 31. *Origanum clinopodioides*; Walt. Carol. 165.)—Leaves ovate, pointed, entire. Flowers capitate and whorled. Bractæas lanceolate, pointed.—Native of mountains in North America, from Pennsylvania to Carolina, flowering

in July and August. *Pursh.* This, like the rest, is perennial. It nearly resembles the last, but differs in having entire leaves, and one or two dense axillary whorls of flowers, besides the solitary terminal heads. The bracteas are also said to be more pointed.

PYCNI, *πυκνι*, in the *Ancient Music*, was used for such sounds or chords of a tetrachord as might enter the spiffum, or *πυκνισ*.

These were the hypatæ, the parypatæ, and the lichani, of the several tetrachords. The hypatæ were called *barypycni*, βαρυπυκνοι; the parypatæ, *mesopycni*, μεσοπυκνοι; and the lichani, *oxypycni*, οξυπυκνοι; because the first were the lowest notes; the second, the middle notes; and the third, the highest of the spiffum. Such chords as could never enter the spiffum were called *apycni*, απυκνοι, *υπατοιιδει*, *παρυπατοιιδει*, *λιχνοιδει*.

Hence, in the Greek scale or diagram, containing eighteen chords, there were five barypycni, as many mesopycni, and an equal number of oxypycni, together with three apycni. The apycni and barypycni were stables or fixed chords; but the mesopycni and oxypycni were moveable, or mobiles.

PYCNITE, in *Mineralogy*, is the mineral called schultze by Klaproth, leucolite by Daubenton, and schorlous beryl by Werner, who first classed it as a subspecies of beryl. It is now arranged with the topaz, to which its constituent parts bear a nearer resemblance. It is remarkable for containing, like the topaz, a portion of fluoric acid. Pycnite is generally found crystallized in long six-sided prisms imbedded in granite rocks. Small four-sided prisms may be obtained by a careful mechanical division from the large crystals; the bases of these are rhombs with angles of 120° and 60°. Bucholz considers this to be the primitive form of pycnite. The colour of this mineral is either various shades of white, passing on one side from greyish and yellowish-white to straw-yellow, or from reddish-white to a peach blossom and crimson red. Some specimens are marked with spots of violet blue. The crystals are translucent. The cross fracture is imperfectly foliated, the longitudinal imperfectly small conchoidal. It is harder than quartz, which it scratches, but is easily broken in a direction perpendicular to the axis of the crystals. Its specific gravity is 3.61. By the analysis of Vauquelin, pycnite contains

Alumine	-	60
Silex	-	30
Fluoric acid	-	6
Lime	-	2
Water	-	1
	-	—
Loss 1.	-	99
	-	—

Bucholz makes the proportion of fluoric acid 17 per cent. There is no less difference in the proportion of fluoric acid in different specimens of the topaz, as given by Klaproth and Vauquelin. See **TOPAZ**. B.

PYCNON, *πυκνον*. See **SPISSUM**.

PYCNOSTYLE, *πυκνοστυλο*, formed from *πυκνος*, close, and *στυλο*, column, in the *Ancient Architecture*, a building where the columns stand very close to one another; one diameter and a half of the column being allowed for the intercolumnation.

The pycnostyle is the smallest of all the intercolumnations mentioned by Vitruvius. Some make it the same with *systyle*; others distinguish the latter by its allowing half a module more in the Corinthian intercolumnation.

The pycnostyle, Mr. Evelyn observes, chiefly belonged

to the Composite order, and was used before the most magnificent buildings; as, at present, in the peristyle of St. Peter's at Rome, consisting of near three hundred columns; and such as yet remain of the ancients among the late discovered ruins of Palmyra.

PYCNOTICS, **INCRASSANTS**, or medicines of an aqueous nature, which have the faculty of cooling and condensing, or thickening, the humours.

The word, in its original Greek, *πυκνωτικον*, signifies something that has the power of thickening.

Purslane, the nenuphar or water-lily, solanum, &c. are ranked among pycnotics.

PYDNA, in *Ancient Geography*, a town of Macedonia, in Pieria, on the coast of the Thermaean gulf, some miles N. of the river Aliacmon. It was near this town that the Romans gained over Perseus the battle which terminated the kingdom of Macedon. Steph. Byz. calls it Cydna.—Also, a town of the Rhodians.—Also, a mountain of the island of Crete.—Also, a town of Asia, in Phrygia, in the vicinity of mount Ida.

PYE, in English *Antiquity*. See **PICA**.

PYE, in *Mechanics*. See **CRAB**.

PYE, in *Ornithology*. See **PICÆ**.

PYE, *Sea*. See **PICA Marina**.

PYE'S ISLANDS, in *Geography*, a cluster of small islands in the North Pacific ocean, near the W. coast of North America. The southernmost forms, in various appearances of it, a very conspicuous peak; its S. extremity is situated in N. lat. 59° 19'. E. long. 210° 21'.

PYGAIA, in the *Materia Medica*, a name by which some authors have called the ipecacuanha, or vomiting Indian root.

PYGARGA, in *Zoology*, a species of *Antelope*; which see.

PYGARGITES, in *Natural History*, a name given by Pliny and some other of the old writers to the eagle-stone, when it was variegated with white, in the manner of the tail of the eagle, called *pygargus*.

PYGARGUS, in *Ornithology*, a species of eagle, called also by some authors *albicilla*, and *birundinaria*. Linnæus has classed this bird among the vultures, calling it the *vultur albicilla*, because its bill is rather straighter than is usual in the eagle; but Mr. Pennant observes, that it can have no claim to be ranked with that genus, because the *pygargus* is wholly feathered; whereas the characteristic mark of the vulture is, that the head and neck are either quite bare, or only covered with down.

It is a large and fierce bird, of the size of the common turkey; its beak is yellow, and covered with a yellow membrane at its base; it has large hazel-coloured eyes; its feet are yellow, and its claws extremely strong and sharp; the head is white, and there are no feathers, but some fine hairs between the eyes and nostrils; the upper part of the neck is of a reddish-brown, and the rump black; all the body besides this is of an obscure rust colour, and its wings are partly black, partly grey; its tail is long, and the upper half of it is white, and the rest black. It is from this white part that it has its name *albicilla*. The male is of a darker colour than the female. This bird inhabits Scotland and the Orkneys, and feeds on fish as well as on land animals.

Authors who have written on this subject seem not at all agreed to call the same bird by this name. The *pygargus* of Aldrovand seems different from this, and the *pygargus* prior of Bellonius seems no other than the male of that kind of hawk, called in English the *hen-barrier*.

Mr. Willughby imagines his first *pygargus*, p. 61, to be only a variety of the white-tailed eagle, having the same charac-

characteristic mark, and differing only in the pale colour of the head.

PYGARGUS *Accipiter*, a name by which many authors have called the subbuteo, a bird of the hawk kind; the male of which is called in English the hen-harrier, and the female supposed by some to be the ring-tail. See **FALCO**.

PYGELA, in *Ancient Geography*, a town of Asia Minor, in Ionia, where was a temple of Venus Munychian, according to Strabo and Steph. Byz.

PYGME, *πυγμα*, the length, or extent, between the elbow, and extremity of the hand, the fist being shut; called also a cubit.

PYGMY, **PYGMÆUS**, *πυγμαῖος*, formed of *πυγμα*, *cubit*, a dwarf, or person of exceeding small stature, not exceeding a cubit in height. See **DWARF**.

The appellation is given among the ancients to a fabulous nation, said to have inhabited Thrace; who generated and brought forth young at five years of age, and were old at eight; famous for the bloody war they waged with the cranes.

PYGMY Ape, in *Zoology*. See **SIMIA** *Sylvanus*.

PYHA, in *Geography*, a large lake of Sweden, in the province of Savolax, N.E. of lake Saima, and communicating with it.—Also, a river of Sweden, which runs into the gulf of Bothnia, at Brahestad.

PYHAJARVI, a town of Sweden, in the province of Nyland; 34 miles N.W. of Helsingfors.

PYHAJOCKI, a town of Sweden, in East Bothnia, near the sea coast; 10 miles S.S.W. of Brahestad.

PYHAMAA, a small island in the gulf of Bothnia, on a peninsula of the coast of Finland. N. lat. 69° 59'. E. long. 21° 12'.

PYKEHAUS, a town of Bengal; 52 miles S.E. of Pucculoe.

PYKER, or **PYCAR**, in our *Writers*, a small ship or herring boat.

PYLA, in *Geography*, a town of the duchy of Warfaw; 48 miles N. of Posen.—Also, a river of England, in Monmouthshire, which runs into the Olwy; 2 miles N.E. of Uik.

PYLADES, in *Biography*. See **BATHYLLUS**, **HYLAS**, **MIME**, and **PANTOMIME**.

PYLÆ PERSIDES, in *Ancient Geography*, a famous strait in Asia, between the Perside and Sufiana, according to Diodorus Siculus. This strait is named *Portæ Persicæ* by Strabo, and *Pylæ Sufiades* by Arrian.

PYLÆ Sarmaticæ. Sarmatia is bounded on the S. by mount Caucasus, which separates it from the neighbouring countries. Ptolemy speaks of two straits or passages in this famous mountain; one called *Portæ Caucasæ*, which affords entrance into Siberia; the other named *Pylæ Albanicæ*, and gives entrance into Albania.

PYLÆA, a town of Macedonia, in Trachinia, situated at the foot of mount Oëta, according to Philostratus. This gave name to the *Pylaic gulf*, mentioned by Strabo.

PYLÆA, *πυλαία*, in *Antiquity*, a name given to the assembly of the Amphictyons, as well when they met at Delphi as at Thermopylæ. The concourse of people at these assemblies was so great, that the term *pylæa* came to be used for any very numerous assembly, or crowd of people. Mem. Acad. Inscr. vol. iv. p. 287. 290.

PYLAGORÆ, *Πυλαγόρες*, a name given to the Amphictyons, because they assembled at Thermopylæ, or Pylæ.

PYLAU, in *Geography*, a town of Prussia; 18 miles S. of Königsberg.

PYLE, **THOMAS**, in *Biography*, was born at Stodey, near

Holt, in Norfolk, in the year 1674. He received his academical education at Caius college, Cambridge, where he took his degrees, and became an excellent scholar. When inducted to the church, he discharged all the duties attaching to his situation as curate with the most conscientious integrity. His great aim was to amend and improve his hearers, and his discourses and urgent manner gained him the attention for which he was anxious. In early life he took part in the Bangorian controversy, and acquitted himself so much to the satisfaction of bishop Hoadly, that his lordship presented him with a prebend, and procured for him a residentiaryship in the cathedral church of Salisbury, and likewise made his two sons prebendaries of Winchester. He died in his 84th year. He was greatly admired as a preacher, and no less so as a faithful friend, an agreeable companion, a man of the most liberal sentiments, and so free from all pride and conceit of his own abilities, that he was apt to pay a deference to the opinions of many persons much inferior to himself. Archbishop Herring speaks of him as a worthy man, but who had not at all times the proper government of his own temper. He was author of several works: as "A Paraphrase, with Notes, on the Acts of the Apostles, and Epistles," being a supplement to Dr. Clarke's Paraphrase on the Four Gospels: "The Scripture Prefervative against Popery; being a Paraphrase, with Notes, on the Revelation of St. John." He published also, between the years 1715 and 1725, "A Paraphrase, with short and useful Notes, on the Books of the Old Testament." In 1773, his friends published two vols. of posthumous sermons, to which, in 1783, a third was added. Though these sermons want the care and polish of finished compositions, they are reckoned interesting and highly useful family discourses.

PYLE-RUDBAR, in *Geography*, a town of Persia, in the province of Ghilan; 32 miles S. of Reshd.

PYLING *the Ground for Foundations*. See **FOUNDATION**, and **PALLIFICATION**.

PYLORIC Artery and Vein, in *Anatomy*, are blood vessels belonging to the stomach. See **STOMACH**.

PYLORUS, the circular ring by which the stomach communicates with the small intestine. See **STOMACH**.

PYLSTART, in *Geography*, an island in the South Pacific ocean, about six miles in circumference, discovered by Tasman in 1643. It presents to view two lofty hills, which seem separated from each other by a low valley: it is called by Maurelle "La Sola." S. lat. 22° 22'. W. long. 175° 59'.

PYLUS Messeniacæ, now *Navarin*, in *Ancient Geography*, was situated on the western coast of Messenia, over-against the island of Asina.

PYLUS (Zonchio), or *Avarino Vecchio*, a town of Messenia, upon the sea-coast, S.E. of Platamodes.

PYLUS Ælianus, a town of Triphylia, N.W. of Onus, upon the Ladan.

PYMATUNING, in *Geography*, a town of America, in Mercer county, Pennsylvania; 23 miles W.S.W. of Fort Franklin. It contains 376 inhabitants.

PYNAKER, **ADAM**, in *Biography*, a landscape painter, was born at the village of Pynaker, near Delft, in 1621. Whether his real name was that by which he is known or not, is not now to be ascertained. By an earnest study of the art, first in his native land, and afterwards at Rome, he acquired very considerable skill and celebrity. He generally exhibits brilliant effects of sunshine, in subjects not always happily selected, but executed with great freshness, purity, and taste. In his pictures we frequently see ruins of elegant and antique buildings, and figures well adapted to the scenery.

scenery. In general his pictures are of a small size, and are rather scarce. He died in 1673, at the age of 52.

PYNANG, in *Botany*, a name by which some authors call the faulcel, or areca-tree; a kind of palm, from the expressed juice of which the drug commonly, but improperly, called Japan-earth is made.

PYNY, in *Geography*, a town of Hindoostan, in Coimbetore; 18 miles S. of Darapurum.

PYONY WATER. See WATER.

PYRACANTHA, in *Botany*, a name given by some authors to the lycium, or box-thorn.

PYRÆIA, or PYRETHIA, among the *Eastern Nations of Antiquity*, were great inclosures uncovered, and dedicated to the sun, in which a perpetual fire was kept up in honour of this luminary, which was worshipped by most of them. See CHAMANIM.

PYRALIS, the *fire-fly*, a name given by authors to a supposed insect, which they say is produced in the violent fires of the glass and metal furnaces. Plin. lib. ii. c. xxxvi. See LAMPYRIS.

PYRAMID, *πυραμς*, in *Geometry*, a solid standing on a square, triangular, or polygonal basis, and terminating at top in a point; or a body whose base is a regular rectilinear figure, and whose sides are plain triangles; their several vertices meeting together in one point.

Euclid defines it a solid figure, consisting of several triangles whose bases are all in the same plane, and have one common vertex.

Wolffius defines it a solid, bounded by as many triangles, ADC, DCB, and ADB, terminating in one point D, as the base ABC has sides. *Plate XI. Geometry, fig. 18.*

The pyramid is said to be *triangular, quadrangular, quin-quangular, &c.* according as the base is triangular, quadrangular, &c. The pyramid may be called a square, triangular, &c. cone; or the cone a round pyramid.

PYRAMID, *Properties of the.* 1. All pyramids and cones standing on the same base, and having the same altitude, are demonstrated to be equal.

2. A triangular pyramid is the third part of a prism, standing on the same base, and of the same altitude.

3. Hence, since every multangular may be divided into triangulars, every pyramid is the third part of a prism, standing on the same basis, and of the same altitude.

4. If a pyramid be cut by a plane, *abc*, parallel to its base, ABC, the former plane, or base, will be similar to the latter.

5. All pyramids, prisms, cylinders, &c. are in a ratio compounded of their bases and altitudes: the bases, therefore, being equal, they are in proportion to their altitudes; and the altitudes being equal, they are in proportion to their bases.

6. Similar pyramids, prisms, cylinders, cones, &c. are in a triplicate ratio of their homologous sides.

7. Equal pyramids, &c. reciprocate their bases and altitudes; *i. e.* the altitude of the one is to that of the other, as the base of this to the base of that.

8. A sphere is equal to a pyramid, whose base is equal to the surface, and its height to the radius of the sphere.

PYRAMID, *to measure the surface and solidity of a.* Find the solidity of a prism that has the same base and height with the given pyramid. And divide this by three; the quotient will be the solidity of the pyramid. Or, multiply the base by the perpendicular height; and one-third of the product will be the content.

Suppose, *v. gr.* the solidity of the prism be found 67010328, the solidity of the pyramid will be thus found 22336776.

The surface of a pyramid is had, by finding the areas, both of a base, ABC, and of the lateral triangles, ACD, CBD, DBA. (See TRIANGLES.) The sum of these is the area of the pyramid.

The external surface of a right pyramid, standing on a regular polygonal base, is equal to the altitude of one of the triangles which compose it, multiplied by the whole circumference of the base of the pyramid.

PYRAMID *on a plane, to describe a.* 1. Draw the base, *v. gr.* the triangle ABC (if the pyramid required be triangular); so as that the side AB, supposed to be turned behind, be not expressed. 2. On AC and CB, construct the triangles ADC and CDB, meeting in any assumed or determined point, *v. gr.* D; and draw AD, CD, BD; then will ADBC be a triangular pyramid.

PYRAMID *of pasteboard, &c. to construct a.* Suppose, *v. gr.* a triangular pyramid required. 1. With the radius AB describe an arc BE (*fig. 19.*); and to this arc apply three equal chords, BC, CD, and DE. 2. On CD construct an equilateral triangle, DFC, and draw the right lines AD and AC. This pasteboard, &c. being cut off by the contour of the figure, what remains within will turn up into a pyramid.

PYRAMID, *Truncated.* See TRUNCATED.

PYRAMID, *Frustum of a.* See FRUSTUM.

PYRAMID, in *Architecture*, denotes a solid, massive edifice; which, from a square, triangular, or other base, rises diminishing to a point, or vertex.

Some derive the word from *πυρος*, *wheat*, and *αμαρ*, *colligo*; pretending that the first pyramids were built by the patriarch Joseph, for granaries. But Villalpandus, with much better reason, derives the word from *πυρ*, *fire*; because of their ending in a point like flame.

Wilkins, conversant with the Coptic tongue, suggests (*Disl. de Ling. Copt.*) another derivation from that language, in which *pouro* signifies a king, and *miss*, a race or generation; and he says, the pyramids were thus called, because they were erected to preserve the memories of the Egyptian kings and their families; and that those who descended from them had recourse to these pillars in order to prove their pedigree.

When they are very narrow at bottom, *i. e.* their base very small, they are called *obelisks*, and *needles*.

Pyramids are sometimes erected to preserve the memory of singular events, and, sometimes, to transmit to posterity the glory and magnificence of princes; but, as they are the symbols of immortality, they are more commonly used as funeral monuments.

Such is that of Cestius at Rome, the mausoleum of this distinguished Roman, who was one of the seven officers called *Epulones*, and is said to have lived under Augustus, repaired in 1673, by Alexander VII. and those other celebrated ones of Egypt, as famous for their size as their antiquity; and reckoned by the ancients among the wonders of the world.

These last are all square in their bases; and it is a thing that has been frequently proposed, to establish a fixed measure from them, to be thereby transmitted to posterity. See their descriptions, measures, &c. in Thevenot, Pietro della Valle, Greaves, Pococke, Shaw, Perry, Maillet, Savary, &c. The pyramids of Egypt, comprehending the great and small, are very numerous; of these there are about twenty of the largest size. The most remarkable are the three pyramids of Memphis, or, as they are now called, of Gheisa, Geeza, or Gize. The dimensions of the greatest of these have been differently stated both by ancient and modern

modern writers. Herodotus (lib. ii.) makes the base of it to be 800 Grecian feet long; Diodorus (lib. i.) 700; Strabo (lib. xvii.) less than 600; and Pliny (lib. xxxvii. c. 12.) 883 feet. Among the moderns, Sandys found it to be 300 paces; Bellonius 324; Greaves 693 English feet; Le Bruyn 704 French feet, or 750 English feet; Prosper Alpinus 750 French feet; Thevenot 682; Niebuhr 710; Chazelles 704.80 English feet. In order to reconcile these differences, Dr. Shaw observes, that none of the sides of this pyramid are exactly upon a level; so that it is difficult to find a true horizontal base; besides, it is impossible to say how much the drifts of sand, to which it is exposed, may have been accumulated above the foundation of it; and, therefore, all calculations depending upon the time and circumstances of the situation, when they were made, must be exceedingly precarious. The perpendicular altitude of it, according to Greaves, is 499 feet; but its oblique height is equal to the breadth of the base, or 693 feet. The whole area of the base contains 480,249 square feet, or $11\frac{1}{3}\frac{2}{3}\frac{2}{3}$ English acres. The height, according to Herodotus, is 800 French feet; according to Strabo 625; according to Diodorus Siculus 600 and a fraction; as stated by Le Bruyn 616; by Prosper Alpinus 625; by Thevenot 520; by Niebuhr 440. The ascent to the top of the pyramid is by steps, the lowermost being near four feet high and three broad; the second of the same dimensions, but retiring inward from the first near three feet; and in the same manner the third row is placed upon the second, and the rest in the same order to the top, which terminates in a small flat or square; and they are so disposed, that a line stretched from the bottom to the top would touch the angle of every step. These steps are called by Herodotus little altars, on account of their form; and their number has been variously assigned; Greaves states them at 207; Maillet at 208; Pococke at 212; Belon at 250; Thevenot at 208, and Chazelles at 498.222 English feet. For a description of the inside of this pyramid, we must refer to Greaves, Savary, &c. *ubi infra*.

This pyramid, being that already described, is situated on a rocky hill, in the sandy desert of Libya, about a quarter of a mile from the plains of Egypt, above which the rock rises 100 feet or more, with a gentle and easy ascent. Upon this advantageous elevation, and solid basis, the pyramid is erected: the height of the situation adding to the beauty of the work, and the solidity of the work affording it a stable support.

We may here observe, that the sides of this pyramid stand exactly facing the four quarters of the world, and consequently mark the true meridian of the place: which precise position could not have been well owing to chance, but was, probably, the effect of design and art; and this is said to be confirmed by the position of the tomb itself, which lies within it. We may hence infer that the Egyptians had made an early progress in astronomy.

The second pyramid stands at about a bow-shot from the first, towards the south of this. Herodotus says, after having measured both, that it falls short of the other in magnitude; that it has no subterraneous chambers, and that the Nile is not conveyed into it by a channel, as into the former, but that it is of an equal altitude. Diodorus informs us, that it resembles the first in its architecture, but is inferior to it in magnitude; each side of the base containing a stadium, or 600 Grecian feet in length, so that by his computation each side is less than that of the former in length by 100 feet. Pliny makes the difference to be greater by 46 feet. Thevenot makes it

but 631 feet square. Strabo supposes these pyramids to be equal, and Greaves assures us, that the bases of both are alike, and that the height is not inferior to that of the first. This pyramid has no entrance like the other, and is built of white stones, not near so large as those of the first: the sides do not rise with gradations, but are smooth and equal, and the whole fabric, except on the south side, is quite entire. On the N. and W. sides of this second pyramid are two very stately and elaborate pieces of architecture, about 30 feet in depth, and about 1400 in length, cut out of the rock in a perpendicular direction and squared by a chisel; supposed to be designed for the lodgings of the Egyptian priests.

The third pyramid stands at about the distance of a furlong from the second, on an advantageous rising of the rock, so that at a distance it appears equal to the former, though it be much less and lower. Herodotus says that it is 300 feet on every side, and to the middle, built of Ethiopic marble. Diodorus gives the same dimensions of its base, and adds that the walls were raised fifteen stories with black stone, like Thebaic marble, and the rest finished with such materials as the other pyramids are built with; that this piece of work, though it be exceeded by the two former in magnitude, yet far excels them in respect to the structure, art, and magnificence of the marble; and that on the side towards the north, the name of Mycerinus, the founder, is engraved; but this inscription has been defaced by time. Pliny writes to the same effect, except that he makes this pyramid 363 feet between the angles.

Dr. Shaw apprehends, that neither of these pyramids was ever finished, supposing that the steps already mentioned should have been filled up with prismatical stones, so that each side of the pyramid might be smooth and level, like that of Cestius at Rome.

But from the description of Maillet and Savary, the first pyramid appears to have been covered with a coating of marble, and thus finished on the outside, but closed; and that it has been since forcibly opened, and the stones which shut the passage and were of an enormous size have been removed. This passage was composed of marble, and the stones which form its four sides are of the finest white and hardest marble. For other particulars we refer to Greaves, Maillet, and Savary.

The ancients inform us, that the stones of the pyramids were brought from the mountains of Arabia, and Herodotus (lib. ii. c. 124.) has described the manner in which they were conveyed; but Dr. Shaw imagines, that they were taken from the spot where they were employed; and he observes, that the greatest of them, especially, is not an entire heap of hewn stones, because that portion of it, which lies below the horizontal section of the entrance, may probably be no more than an incrustation of the natural rock on which it is founded. Dr. Bryant conjectures, that, like the sphynx, which stands directly in the front of the second pyramid, they were immense rocks which stood upon the brow of the mountain; that the Egyptians cased them over with large stones, and brought them by these means to a degree of symmetry and proportion. At the same time they filled up the unnecessary interstices with rubbish and mortar, and made chambers and apartments, as the intervals in the rock allowed, being obliged to humour the indirect turns and openings in the original mass to execute what they proposed. This he infers from the narrowness and unnecessary sloping of the passages, which are often very close and steep, and also from the fewness of the rooms in a work of so immense a structure. That the pyramids were built upon a rock in the place where they

now stand, was suggested by Mr. Hooke. See Birch's Hist. Royal Society, vol. iv. p. 245.

It is very surprising that the pyramids, which have been reckoned among the wonders of the world, should not have preserved a more certain era, and tradition of the names of their founders. Pliny reckons a number of authors who have wrote concerning them; and all, he informs us, disagree in their accounts of those who built them. Some modern writers maintain, that they were erected by the Israelites, under the tyranny of the Pharaohs, and allege to this purpose the testimony of Josephus, Antiq. lib. i. cap. 5.

According to the relations of Herodotus (lib. ii.), and Diodorus (lib. i.), the first pyramid was erected by Cheops, or Chemmis, a king of Egypt, who is said to have employed three hundred and sixty thousand men for twenty years in the structure. Cephren, brother and successor to the former king, is said to be the founder of the second pyramid; and the third is said to have been built by Mycerinus, the son of Chemmis, according to Diodorus, but according to Herodotus, of Cheops. However, Herodotus says, that some ascribed the last to Rhodope, a courtizan, and the other two to the shepherd Philition. The learned Greaves places the three kings who erected these pyramids in the twentieth dynasty; Cheops having begun his reign in the year 3448 of the Julian period, 490 years before the first olympiad, and 1266 years before the Christian era. He reigned fifty years, says Herodotus, and built this pyramid, as Diodorus observes, 1000 years before his time, or in the 180th olympiad; whereas, he might have said 1207. Cephren, the builder of the second, reigned fifty-six years; and Mycerinus, the builder of the third, seven years.

Dr. Bryant gives a different account of the origin of these pyramids: he ascribes the structure of them to the Cushites (see DISPERSION of Mankind), or Arabian shepherds, who built Heliopolis, and who were the giants and Titans of the first ages. These sons of Chus, according to this writer, seem to have come into Egypt immediately after their dispersion from Babel.

Many have considered these ancient structures with contempt, as being vast piles without any great symmetry, and have thought the labour idle, and the expence unnecessary. Thus Pliny (lib. xxxvi. cap. 12.) calls them *regum pecunie otiosa ac stulta ostentatio*, &c. built for ostentation, to keep an idle people employed, and to prevent commotion and rebellion. Aristotle (Polit. lib. iii.) calls them the work of t ranny.

The general opinion with regard to their intention and use is, that they were sepulchres and monuments of the dead, particularly of kings. This is expressly affirmed by Diodorus (lib. i.), and Strabo (lib. xvii.), and the opinion is confirmed by the writings of the Arabians. And the reason, says Greaves, of their erecting these magnificent structures is founded in the theology of the Egyptians, who, as Servius shews in his comment upon Virgil (*Æneid*, lib. iii.), where he describes the funeral of Polydorus—*Animamque sepulchro condimus*—believed, that as long as the body endured, so long the soul continued with it; and this was also the opinion of the Stoics. Upon this principle, that the bodies might neither be reduced to dust by putrefaction, nor converted into ashes by fire, they embalmed them, and laid them up in these stately repositories, where they might continue free from the injury of time and of men. The reason of their building their sepulchres in the form of pyramids, was either from a notion that this was the most permanent form of structure, or because they

hereby intended to represent some of their gods: particularly, as Greaves conjectures, Osiris, or the sun with many rays; for, under this form, the statues of the gods were frequently exhibited, and the gods themselves worshipped.

Among the Egyptians, the pyramid is said to have been a symbol of human life; the beginning of which is represented by the base, and the end by the apex; on which account it was that they used to erect them on sepulchres. Herodotus.

Some, however, have objected to this design of the Egyptian pyramids, and are of opinion that they were originally intended for some nobler purpose. If Cheops, or any other person, says Dr. Shaw, who was the founder of the great pyramid, intended it only for his sepulchre, what occasion was there for such a narrow crooked entrance into it; for the well, as it is called, at the end of the entrance; for the lower chamber, with a large niche or hole in the eastern wall of it; for the long narrow cavities in the walls of the upper room; or, for the two antichambers and the lofty gallery, with benches on each side that introduce us into it.

As the whole of the Egyptian theology was clothed in mysterious emblems and figures, it seems reasonable to suppose, says this writer, that all these turnings, apartments, and secrets in architecture were designed for some purpose of religion, and that the Deity, which was typified in the outward form of this pile, was to be worshipped within. The square chest of granite marble, which is placed in the upper chamber of the great pyramid, may be supposed to have been rather intended for some religious use than for the coffin of Cheops. It might have served for one of their sacred chests, in which either the images of their deities, or their sacred vestments or utensils were kept, or it might have been a *savissa* or cistern, such as contained the holy water used in their ceremonies. Its length favours the opinion of its having been designed for a coffin, but its height and breadth far exceed the dimensions that were adhered to on such occasions; the Egyptian stone coffins were made of a different form, and inscribed with hieroglyphics. Nor is this chest placed according to the manner in which the Egyptians deposit their dead; for their mummies always stand upright, whereas this chest lieth flat upon the floor. If, therefore, this chest was not intended for a coffin, it is inferred that the pyramid itself could not have taken the name of a sepulchre from it. Cheops, indeed, and others might have been buried within the precinct of this or any other of the pyramids, and this was no more than was practised in other temples, and therefore could not destroy the principal use and design for which they were erected. Upon the whole, Dr. Shaw concludes, from the outward figure of these piles, the structure and contrivance of the several apartments in the inside of the greatest, together with the ample provision that was made on each side of it for the reception, as may be supposed, of the priests, that the Egyptians intended the latter for one of the places, as all of them were to be the objects, at least, of their worship and devotion.

Dr. Bryant has lately maintained, with considerable force of argument, this opinion, that the pyramids were designed for high altars and temples, and were constructed in honour of the Deity. If the chief pyramid was designed for a place of burial, what occasion, says he, was there for a well, and for passages of communication, which led to other buildings? The apartments near the pyramids he supposes to be designed for the reception of priests, and to be appendages not to a tomb, but to a temple of the Deity.

The stone coffin, he apprehends, was a trough or reservoir for water, which, by means of the well, they drew from the Nile. The priests of Egypt delighted in obscurity, and they probably came by the subterraneous passages of the building to the dark chambers within; where they performed their lustrations, and other nocturnal rites. Many, he adds, of the ancient temples in this country were caverns in the rock, enlarged by art, and cut out into numberless dreary apartments; for no nation upon the earth was so addicted to gloom and melancholy as the Egyptians. From the top of the pyramids they observed the heavens, and marked the constellations; and upon the same eminence it is probable that they offered up vows and oblations. See on this article Greaves's Works, vol. i. p. 1, &c. Shaw's Travels, fol. p. 413, &c. Pococke's Descript. of the East, vol. i. p. 41, &c. Perry's View of the Levant, p. 413, &c. Bryant's Anal. of Ancient Myth. vol. iii. p. 523, &c. Farmer's Worship of Human Spirits, &c. p. 379, &c. Savary's Letters, vol. i.

The tomb of Porfenna, king of Etruria, at Clusium in Italy, is an ancient monument of square stone, each side of which is three hundred feet broad, and fifty feet high. Within the square base there is an inextricable labyrinth; upon this square there stand five pyramids, four in the angles and one in the middle, seventy-five feet broad at the bottom, and a hundred and fifty feet high, and terminating in a point; at top they are covered with a brass circle, from which are suspended bells, which are put in motion by the wind, so as that their sound may be heard at a great distance. Upon this circle there are four other pyramids, each a hundred feet high, above which, upon one plane, there are five other pyramids. Such is the account which Pliny gives from Varro, lib. xxxvi. cap. 13.

PYRAMID, *Scenography of a*. See SCENOGRAPHY.

PYRAMID, *Optic*. See OPTIC Pyramid.

PYRAMIDAL FOUNTAIN. See FOUNTAIN.

PYRAMIDAL Mirrors. See MIRROR.

PYRAMIDAL Numbers are the sums of polygonal numbers, collected after the same manner as the polygonal numbers themselves are extracted from arithmetical progression. See NUMBERS.

These are particularly called *first* pyramidal. The sums of first pyramidal are called *second* pyramidal. And the sums of those *third* pyramidal; and so on, *ad infinitum*. Particularly, those arising from triangular numbers are called *prime triangular* pyramidal; those arising from pentagonal numbers are called *prime pentagonal* pyramidal, &c. The numbers 1, 4, 10, 20, 35, &c. formed by the addition of the triangular numbers 1, 3, 6, 10, &c. are usually called by the simple name of pyramidal; and the general formula

for finding them is $n \times \frac{n-1}{2} \times \frac{n-2}{3}$; i. e. the fourth

pyramidal may be found by substituting 4 for n ; the fifth, by substituting 5 for n , &c.

PYRAMIDALIA CORPORA, in *Anatomy*, two prominences in the medulla oblongata. See BRAIN, and NERVOUS System.

PYRAMIDALIS ABDOMINIS, one of the abdominal muscles. See OBLIQUUS.

PYRAMIDALIS Nasi, a name given by some anatomists to that portion of muscular fibres which descends from the fronto-occipitalis along the side of the nose. See EPICRANII.

PYRAMIDOID, called also *parabolic spindle*, a solid figure, formed by the revolution of a semiparabola round one of its ordinates.

According to the method of indivisibles, this may be conceived to consist of an infinite series of circles, whose diameters are all parallel to the axis of the revolving parabola.

The parabolic spindle is equal to $\frac{2}{3}$ ths of its circumscribing cylinder. See SPINDLE.

PYRAMIDOID, *Parabolic*. See PARABOLIC Pyramidoid.

PYRAMIDS, in *Geography*, rocks in the East Indian sea, near the E. coast of the island of Myfol. S. lat. 1° 55'. E. long. 130° 59'.

PYRAMUS, GIIUX, in *Ancient Geography*, a river of Asia, rising in the country of Cataonia, where it begins to be navigable, and traversing mount Taurus through the rocks, it enters the plain of Cilicia, passes by the foot of the mountain of Anazarbus, and leaving it to the right, throws itself into Mopsuete, and at length loses itself in the Mediterranean, at the point where was formerly situated the town of Megarus.

PYRBAUM, in *Geography*, a town of Bavaria, and capital of a lordship united to Salzburg; 13 miles S.E. of Nuremberg.

PYRENÆUM PROMONTORIUM, *Cape de Creus*, in *Ancient Geography*, a promontory of Hispania Citerior; which terminates the Pyrenées eastwards, and projects into the sea.

PYRENÆUS SALTUS, a name given by Cornelius Nepos and Livy to that part of the Pyrenæan mountains which Hannibal traversed in his way to Italy, passing from Spain to Gaul.

PYRENE, a town of Gallia Celtica, near the place where the Danube rises, according to Herodotus.

PYRENE, in *Natural History*, the name of a stone found always in the shape of the stone of an olive. It is of the lapis Judaicus kind, being no other than the petrified spine of some species of echinites.

PYRENE'ES, in *Geography*, a chain of mountains, celebrated since the time of Herodotus, forming the boundaries between France and Spain, and extending from the Mediterranean to the Atlantic, about 200 miles in length, and in its greatest breadth 100 miles. Its various branches are distinguished by different names, and may be considered as belonging either to France or Spain. The highest summits of these mountains, which are in the centre of the chain, have presented to the research of the naturalist not only calcareous appearances, but even shells. The highest elevation of the Pyrenées is *Mont PERDU*, for an account of which, we refer to that article. The Canigou was formerly reckoned the highest summit, though it does not exceed 8544 English feet. Other noted heights are Tuccarroy, Marboré, the pic de Midi, 9300 feet high, the pic de los Reyes, 7620 feet high, the pic d'Ossano 11,700 feet in height, the pic d'Arni, the Nieve Veille, the Vigne Mali, La Breche de Roland, &c. At a distance the Pyrenæan chain appears like a shaggy ridge, presenting the segment of a circle fronting France, and descending at each extremity till it disappears in the ocean and Mediterranean. Thus, at St. Jean de Luz, only high hills appear, and in like manner on the east beyond the summit Canigou, the elevations gradually diminish. The highest summits are covered with perpetual snow. Blocks of granite are interspersed with vertical bands, argillaceous and calcareous, the latter primitive or secondary, and supplying the marbles of Campan and Antin, of beautiful red spotted with white, though the general mountain mass be grey. To the S. and W. the Pyrenées present nothing but dreadful sterility, but on the N. and E. the descent is more gradual, and affords frequent woods and pastures. Besides the dreadful fall of

rocks, undermined by the waters, they are exposed to Lavanges, or the impetuous descent of vast masses of snow, called Avalanches in Switzerland, and have their glaciers and other terrific features of the Alps.

The opinion of Ramond, that the summit of mont Perdu (which see) must have been covered by the sea, is confirmed by Lapeyrouse, (Journ. des Mines, N° 46.) A singular feature of the Pyrénées consists of *boules*, as they are called, or walls disposed in a circular form. Near the summit of mont Perdu is a considerable lake, more than 9000 feet above the level of the sea, which throws its waters to the E. into the Spanish valley of Beoussa; and which the travellers allege as a proof that mont Perdu really belongs to Spain, and that Tucarrois forms the boundary. Lapeyrouse suggests it as probable that the sole access to the summit of mont Perdu will be found on the side of Spain; there being three summits called by the Spaniards "Las Tres Sorrellas," or the Three Sisters; the highest being to the N., and the lowest on the S., but separated by large glaciers. Hence he infers the existence of chains of mountains, in which bands of granite, porphyry, trap, hornblende, and petrofilix, alternate vertically with primitive limestone, and are so intermingled as to prove a common origin. But in the Pyrénées these bands are surmounted by secondary lime-stone, replete with marine spoils, and containing even skeletons of animals, so that he concludes that the highest mountains of the chain must have yielded to the fury of the ocean, and that the secondary parts only now exist. Mr. Townsend (Spain, i. 89.) observes, that the lime-stone and schistus feed the vegetation on the N. of the Pyrénées, while the S. is barren, and consists of granite; while, in fact, mountains are generally barren and precipitous on the S. and W., because the most violent rains and tempests come from those regions. Pinkerton's Geog. vol. i.

The passages over these mountains from one country to another are five; the three principal of which are from St. Sebastian to St. Jean de Luz; from Pamplona to St. Jean de Luz; and from Jonqueira to Perpignan. These mountains afford quantities of timber for shipping, which are conveyed, by means of the Ebro and other streams to the sea, with abundance of pitch and tar. The Pyrénées give name to three of the French departments.

PYRÉNÉES, Eastern, one of the nine departments of the southern region of France, in N. lat. $42^{\circ} 40'$, formerly Roussillon, bounded on the N. by the departments of the Arrière and the Aude, on the E. by the Mediterranean, on the S. and W. by Spain; about 58 miles from E. to W., and from 18 to 25 from N. to S., or 28 Fr. leagues in length, and 15 in breadth, containing 4337½ kilometres or 212 square leagues, and 117,764 inhabitants; it is divided into 3 districts, 17 cantons, and 249 communes. The three districts are Perpignan, including 51,961 inhabitants, Ceret, 24,750, and Prades, 41,053. According to Hasselfratz, the number of circles is 3, of cantons 25, and of inhabitants 114,158. The contributions in the 11th year of the French era amounted to 1,010,520 fr., and the expences for administration, education, &c. to 181,961 fr. 85 cents. The capital is Perpignan. This department is fertile in corn, wine, oil, flax, hemp, fruits, and pastures. On the hills there is little wood, but variety of medicinal plants and herbs. There are several lofty mountains on the S. and W. boundaries, as Massane, Canigou, &c.

PYRÉNÉES, Lower, a department of France, in the S.W., or Garonne region, composed of Bearne, Navarre, Basque-Français, with a part of Chalosse and of Landes, in N. lat. $43^{\circ} 10'$, and bounded on the N. by the departments of the Landes and Gers, on the E. by the department of the

Upper Pyrénées, on the S. by Spain, and on the W. by the sea; 70 miles in length, and from 15 to 45 in breadth, or 16 Fr. leagues in length and 10 in breadth. It contains 8072½ kilometres, or 388 square leagues, and 384,030 inhabitants. It is divided into 5 districts, 40 cantons, and 660 communes. The districts or circles are, Pau, including 99,486 inhabitants, Oleron, 69,484, Mauleon, 65,447, Bayonne, 69,486, and Orthez, 80,127. According to Hasselfratz, its circles are 6, its cantons 44, and the number of its inhabitants 138,339. Its capital is Pau. Its contributions in the 11th year of the French era amounted to 1,523,760 fr. and its expences for administration, &c. to 290,740 fr. 66 cents. This department, bounded on one side by the Pyrénées, and on the other by the ocean, presents a great variety of soil and diversity of prospect. The mountains are crowned with woods; the hills are covered with vines; the vallies are rich and populous; the heaths are wild and uncultivated. The plains yield wheat, rye, barley, oats, millet, flax, fruits, and pastures. It has mines of silver, copper, iron, quarries of marble, granite, slate, and mineral springs.

PYRÉNÉES, Upper, a department of France, in the Garonne region, formerly Bigorre, in N. lat. 43° , bounded on the N. by the department of the Gers, on the E. by that of the Upper Garonne, on the S. by Spain, and on the W. by the department of Lower Pyrénées; 20 Fr. leagues long and 16 broad, or 53 English miles in length, and from 25 to 38 in breadth; a small district towards the N. being scarcely more than seven miles in breadth. It contains 4937½ kilometres, or about 235 square leagues, and 206,680 inhabitants. It is divided into 3 districts, 26 cantons, and 501 communes. Its districts or circles are Tarbes, including 87,005 inhabitants, Bagnères, 78,099, and Argelès, 41,376. According to Hasselfratz, its circles are 5, and cantons 30, and the number of its inhabitants 188,690. Its capital is Tarbes. Its contributions in the 11th year of the French era amounted to 893,637 fr. and its expences for administration, &c. to 173,759 fr. 12 cents. The plains in this department yield little wheat, but abundant crops of rye, barley, and millet, excellent wine, flax, and pastures. The hills produce considerable forests, with mines of iron and lead, quarries of marble, slate, and mineral springs.

PYRÉNOIDES PROCESSUS, in *Anatomy*, a process of the second vertebra of the neck; called also *odontoides*, and *dentiformis*, or the tooth-like process.

The word *πυρηνόειδος*, is formed of *πυρην*, *nucleus*, *kernel*, or *berry*, and *ειδος*, *figure*.

PYRETHRUM, in *Botany*, an ancient Greek name, adopted by Haller, Gärtner, and the writer of the present article, who are followed by Willdenow and Aiton, for the genus in question, on account of its resemblance to the *πυρεθρος* of Dioscorides. The latter is, however, the *Anthemis Pyrethrum* of modern writers, or Pellitory of Spain; owing its Greek appellation to the fiery or pungent flavour of the root; whence also it obtained the Latin name of *Salivaria*, because it causes so remarkable a flow of saliva. Our present *Pyrethrum* is made up of several Linnæan species of *Chrysanthemum* and *Matricaria*, with some new ones.—Haller Helvet. v. 1. 40. Sm. Fl. Brit. 900. Willd. Sp. Pl. v. 3. 2150. Ait. Hort. Kew. v. 5. 97. Pursh v. 2. 527. Gärtner. t. 169.—Class and order, *Syngnæsia Polygamia-superflua*. Nat. Ord. *Compositæ discoideæ*, Linn. *Corymbifera*, Juss.

Gen. Ch. *Common Calyx* hemispherical, imbricated; the scales close-pressed, rather acute, membranous at the edges. *Cor.* compound, radiated. Florets of the disk perfect, numerous,

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numerous, tubular, funnel-shaped, with five spreading segments; those of the radius more than 12, female, ligulate, elliptic-oblong, three-toothed. *Stam.* in the perfect florets. Filaments five, capillary, very short; anthers united into a cylinder, hardly so long as the corolla. *Pist.* Germen, in all the florets, obovate; style thread-shaped, longer than the stamens; stigmas two, divaricated, abrupt. *Peric.* none, the calyx remaining unaltered. *Seeds* nearly alike in all the florets, oblong, quadrangular, each crowned with an erect, membranous, more or less lobed border. *Recept.* naked, dotted, convex.

Eff. Ch. Receptacle naked. Seeds crowned with a membranous margin. Calyx hemispherical, imbricated with sharpish scales, bordered with a membrane.

Section 1. *Radius white; rarely reddish.*

1. *P. frutescens.* Shrubby Feverfew. Willd. n. 1. Ait. n. 1. (*Chrysanthemum frutescens*; Linn. Sp. Pl. 1251. *Leucanthemum canariense*, sapore pyrethri; Walth. Hort. 31. t. 24. *Bupthalmum canariense leucanthemum*; Pluk. Almag. 73. Phyt. t. 272. f. 6.)—Stem shrubby. Leaves fleshy, pinnatifid, linear, toothed; three-cleft at the extremities.—Native of the Canary islands, from whence it was brought very early; flowering in the green-house most part of the year. The woody stem is much branched. The leaves are crowded about the ends of the branches, and in their fleshy texture, as well as linear forked figure, resemble those of a *Crithmum*, or *Artemisia*. The flowers are terminal, solitary, on long naked stalks, and resemble a white daisy.

2. *P. simplicifolium.* Simple-leaved West Indian Feverfew. Willd. n. 2. (*Matricaria? prostrata*; Swartz Ind. Occ. v. 3. 1366.)—Leaves obovate; toothed at the extremity. Stalks axillary, single-flowered. Branches prostrate. Gathered by Von Rohr in Curaçao and the neighbouring islands. It has never been brought alive to Europe. Stem herbaceous, branched, decumbent, round, downy, especially the ends of the branches. Leaves alternate, nearly sessile, wedge-shaped, obovate, or roundish, half an inch long, downy, ribbed, notched or serrated; mostly accompanied by two minute leaves at the base. Stalks opposite to the leaves, thickish, an inch long, erect, downy, each bearing a yellowish-white, nearly globose, flower, whose disk is entirely yellow. Seeds crowned with a quadrangular minute border. Swartz.

3. *P. ptarmicifolium.* Goose-tongue Feverfew. Willd. n. 3. Ait. n. 2.—Leaves linear, finely serrated. Flowers corymbose.—Native of mount Caucasus. Sir Joseph Banks sent it to Kew in 1803. Willdenow describes this as perennial, with the habit of *Achillea Ptarmica*, only the flowers are twice as large. The stem is branched, either erect or decumbent. Leaves an inch long, very finely and sharply serrated. Corymbs terminal, simple, the stalks single-flowered. Radiant florets ovate. Crown half the length of the seed.

4. *P. serotinum.* Creeping-rooted Feverfew. Willd. n. 4. Ait. n. 3. Pursh n. 1. (*Chrysanthemum serotinum*; Linn. Sp. Pl. 1251. Jacq. Obs. fasc. 4. 8. t. 90. *Bellis americana*, procerior, serotina, ramosa, flore amplissimo; Pluk. Almag. 65. Phyt. t. 17. f. 2.)—Leaves lanceolate; the lower ones strongly serrated; the upper entire. Branches corymbose.—Supposed to be a native of North America; but Michaux has it not, and Pursh merely saw a specimen in Mr. Lambert's herbarium, probably, like that of Linnæus, from a garden. The plant was cultivated by Miller, and is a hardy perennial, flowering in October or later. Its stem is herbaceous, two or three feet high, much branched, leafy, furrowed and angular. Leaves alternate,

flexile, two or three inches long, and half an inch wide, entire or sparingly serrated in the upper parts of the stem, but mostly furnished, in our specimen, with a sharp tooth on each side at the base, which we do not find mentioned by authors. The flowers are terminal, solitary, much like our common *Chrysanthemum Leucanthemum*, but rather smaller.

5. *P. uliginosum.* Bog Feverfew. Willd. n. 5. Waldst. et Kitaib. Hungar.—“Leaves lanceolate, all deeply serrated. Stem erect, branched at the top.”—Native of wet ground in Hungary and Spain. Perennial. Very nearly akin to the last, but different in having all the leaves deeply serrated throughout, and the stem branched at the top only. Willd.

6. *P. Halleri.* Hallerian Feverfew. Willd. n. 6. (P. n. 97; Hall. Helvet. v. 1. 41. *Leucanthemum alpinum tenuifolium*; Barrel. Ic. t. 458. f. 3?)—Stem-leaves lanceolate, deeply toothed; radical ones pinnatifid, on long stalks. Stem single-flowered.—Native of the Swiss alps, in stony places. The roots are creeping, black, long and slender, with very long fibres. Stems solitary, simple, leafy, ascending, three or four inches high. Leaves smooth; the lowermost short, wedge-shaped, deeply pinnatifid, on long stalks; the uppermost sessile, deeply and sharply toothed, an inch or more in length. Flowers solitary, stalked, terminal, large; the calyx-scales bordered with black; the radiant florets broad and elliptical. The above figure of Barrelier seems to accord better with our Swiss specimens than fig. 2. cited by Haller and his copyists, except that the upper leaves in fig. 3. are too narrow.

7. *P. alpinum.* Alpine Feverfew. Willd. n. 7. Ait. n. 4. (*Chrysanthemum alpinum*; Linn. Sp. Pl. 1253. *Leucanthemum alpinum*; Clus. Hist. v. 1. 335.)—Lower leaves wedge-shaped, pinnatifid; uppermost linear and entire. Stem single-flowered.—Native of the German, Swiss and Italian alps. The creeping roots throw out many short tufted leafy stems, each bearing one long simple flower-stalk, downy in its upper part, and furnished below with one, two, or more, alternate, simple, linear, entire floral leaves. The rest of the foliage is stalked, pinnatifid, somewhat pectinate; the segments elliptical, entire, smooth, rather fleshy; each leaf, with its flat stalk, an inch or more in length. The flower is large, much like the last.

8. *P. Balfamita.* Costmary-leaved Feverfew. Willd. n. 8. Ait. n. 5. (*Chrysanthemum Balfamita*; Linn. Sp. Pl. 1252. Jacq. Obs. fasc. 4. 8. t. 89. *Leucanthemum orientale*, costi hortensis folio; Tourn. Cor. 37.)—Leaves ovate-oblong, serrated, auricled. Flowers corymbose.—Native of the Levant; rare in our gardens. Mr. Blackburne is said to have cultivated it in his celebrated collection at Orford about 35 years ago. The habit of this species is so much like Common Costmary, *Tanacetum Balfamita* of Linnæus, that one cannot help suspecting they are mere varieties of each other. The preference of a radius, in the plant before us, is known, by the examples of *Bidens* and *Coreopsis*, to be no infallible distinction. There is indeed the membranous crown of the seed, as Willdenow remarks, which makes this a *Pyrethrum*, not a *Chrysanthemum*; but such belongs to *Tanacetum*, and confirms our suspicion, or rather our belief, that the present is but a radiated variety of the Costmary. The radius is about twice the length of the calyx, white, not yellow, as Linnæus seems to describe it.

9. *P. palustre.* Marsh Feverfew. Willd. n. 9. (*Leucanthemum orientale*, chrysanthemi folio, tanacetii odore; Tourn. Cor. 37.)—“Leaves smooth, sessile, lyrate-pinnatifid. Stalks single-flowered, corymbose.”—Native of marshy places in Armenia. Tournefort.—Stem erect, furrowed, smooth, two feet high. Leaves an inch or inch and

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and half long; their segments lanceolate, toothed at the outer margin, the lower ones deep, the upper gradually confluent into a large cut terminal lobe, and entire. *Stalks* single-flowered, leafy, alternate, five or six at the top of the stem, composing a *corymbus*. *Flowers* the size of *Chrysanthemum Leucanthemum*. Willd.

10. *P. pinnatifidum*. Pinnatifid Feverfew. Willd. n. 10. —“Leaves downy, glaucous, nearly sessile, lyrato-pinnatifid, unequally toothed. *Flowers* corymbose.” — Willdenow described this from living specimens, but did not know their native country. The *stem* is said to be erect, two feet high, branched, furrowed, slightly downy. *Leaves* downy on both sides; pinnate at the base; pinnatifid in the middle; cut at the end; their length two or three inches; their segments lanceolate, unequally toothed. *Corymbs* simple, at the tops of the stem and branches. *Flowers* almost like the common *P. Parthenium*.

11. *P. macrophyllum*. Large-leaved Feverfew. Willd. n. 11. Ait. n. 6. (*Chrysanthemum macrophyllum*; Waldf. et Kitaib. Hung. v. 1. 97. t. 94.) — Leaves hairy, nearly sessile, pinnatifid, toothed, obtuse. *Corymb* terminal, compound. — Native of the woods and mountains of Hungary. Sir J. Banks introduced it, in 1803, to the Kew garden, where it is a hardy perennial, flowering in July and August. This plant resembles *Achillea macrophylla*, for which some botanists have mistaken it, but is much larger. We have seen no specimen.

12. *P. roseum*. Rose-coloured Feverfew. Ait. n. 7. Willd. Enum. 905. (*Chrysanthemum coccineum*; Willd. Sp. Pl. v. 3. 2144. Sims in Curt. Mag. t. 1080. *Buphthalmum orientale*, *tanacetifolium* ampliore, flore magno coccineo; Tournef. Cor. 37. Buxb. Cent. 2. 25. t. 20.) — Leaves smooth, pinnate; leaflets once or twice pinnatifid, ferrated, acute, spreading. *Stem* erect, single-flowered. Gathered by Tournefort in Iberia. It is found also on mount Caucasus, from whence that distinguished cultivator Mr. Loddiges received seeds of this elegant species in 1803. The plant proves perennial and hardy, flowering in August or September. The *stem* is 12 or 18 inches high, more or less leafy, bearing one large handsome flower, whose disk is yellow, and the radius of a rich rose colour, or crimson, on its upper side; sometimes varying to white. The *leaves* are from two to four inches long, stalked, rigid, paler beneath, pinnate, variously ferrated, cut or pinnatifid, all the points and ferratures very acute. Tournefort gathered plenty of this plant, and his original specimens are dispersed through many collections.

13. *P. corymbosum*. Mountain Feverfew. Willd. n. 12. Ait. n. 8. (*Chrysanthemum corymbosum*; Jacq. Austr. t. 379. *Ch. corymbiferum*; Linn. Sp. Pl. 1251. *Tanacetum non odoratum*; Ger. Em. 650.) — Leaves pinnate; leaflets lanceolate, pinnatifid, sharply ferrated; the upper ones confluent. *Flower* stalks corymbose. — Native of mountainous woods in Siberia, and many parts of Germany. Gerard appears, by the catalogue of his garden, to have cultivated it in 1596. The *root* is perennial, woody, with long fibres. *Stems* erect, two or three feet high. *Leaves* somewhat like Tanfy, but without scent or taste, except that after a while, according to Jacquin, they cause a heat or pungency in the mouth. The numerous large white flowers, each with a bright yellow disk, form an ample terminal corymb.

14. *P. Parthenium*. Common Feverfew. Sm. Fl. Brit. n. 1. Engl. Bot. t. 1231. Willd. n. 13. Ait. n. 9. (*Matricaria Parthenium*; Linn. Sp. Pl. 1255. Woodv. Suppl. t. 249. Fl. Dan. t. 674. *Matricaria*; Ger. Em. 652.) — Leaves pinnate; leaflets oblong, obtuse, pinnatifid

and cut. *Stem* branched. *Flowers* corymbose. *Radius* about twice the length of the *calyx*. *Seed-crown* toothed. — Native of cultivated or waste ground throughout Europe, springing up abundantly with us in neglected gardens or court-yards, flowering all summer long. The *root* appears to be rather biennial than perennial. The whole *herb* is bitter and aromatic, hoary or downy. *Stem* bushy. *Leaves* stalked, flat and dilated. *Flowers* numerous, each about the size of a common daisy, but with a large yellowish disk, and short white radius. Sometimes the latter is wanting; and more frequently the flowers are double, the disk becoming white and ligulate, like the radius, but each *floret* of a smaller proportion. The *receptacle* is flat.

15. *P. parthenifolium*. Narrow Hoary Feverfew. Willd. n. 14. —“Leaves pinnate; leaflets oblong, obtuse, pinnatifid, toothed. *Stem* wand-like. *Flowers* corymbose. *Radius* thrice the length of the *calyx*. *Seed-crown* entire.” — Willdenow described this from a garden, without knowing whence it came. He says it is very like the last, but has a taller wand-like *stem*, narrower *leaves*, a *disk* but half so large, though the *radius* is larger, and an entire, not toothed, margin to the *seed*. A plant, now become a weed in Kew garden, and said to have been imported from China, answers precisely to this description in every point, except that its *stem* is scarcely less bushy than in *P. Parthenium*. We are persuaded, nevertheless, that it is what Willdenow meant. Its *leaves* are conspicuously hoary, with narrower divisions than those of the last, and the *flowers*, on account of their long and brilliant-white *radius*, are more striking. We have had no opportunity of investigating the crown of the *seed*.

16. *P. caucasicum*. Caucasian Feverfew. Willd. n. 15. Ait. n. 10. —“Leaves doubly pinnate; leaflets linear-awl-shaped. *Stem* single-flowered.” — Native of mount Caucasus. Sent to Kew in 1804, by the late Mr. G. Don. “*Root* woody, horizontal. *Stem* a span high, simple, striated, smooth. *Leaves* half an inch long, sessile, doubly pinnate; their leaflets linear-awl-shaped, entire. *Flower* solitary, the size of *P. alpinum*, or rather larger. *Seed-crown* membranous, two-lobed.” Willd.

17. *P. fuscatum*. Dingy Feverfew. Willd. n. 16. Sm. Prodr. Fl. Græc. Sibth. n. 2095. (*Chrysanthemum fuscatum*; Desfont. Atlant. v. 2. 283. t. 237.) — Leaves downy, pinnate; leaflets with a few deep linear oblong segments. *Stem* branched from the base, diffuse. — Gathered by Desfontaines in uncultivated fields near Tunis. Sibthorp found it in Greece. The *root* appears to be perennial, bearing many widely-spreading or procumbent *stems*, a span long, which are leafy, and slightly branched. The *leaves* are rather succulent. *Flowers* terminal, solitary, large, with a blackish *calyx*, pale yellowish disk, becoming brown in decay, and broad white elliptical radiant florets. It blossoms in winter.

18. *P. inodorum*. Corn Feverfew, or Scentless May-weed. Sm. Fl. Brit. n. 2. Engl. Bot. t. 676. Willd. n. 17. Ait. n. 11. (*Chrysanthemum inodorum*; Linn. Sp. Pl. 1253. Fl. Dan. t. 696.) — Leaves pinnate, in many capillary segments. *Stem* branched, spreading. *Seed-crown* entire. — Found in fields and waste ground throughout most parts of Europe, especially where the soil is gravelly, flowering in autumn. *Root* tapering, annual. *Herb* almost without any peculiar scent, by which it is readily known, in every state of growth, from *Antibensis Cotula*. The *stem* is a foot or more in height, widely spreading, clothed with pale-green smooth *leaves*, whose leaflets are deeply and variously divided into linear, almost capillary, pointed segments. More simple segments are
numerously

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numerously crowded about the bottom of each *leaf*, rendering it, in a manner, lyrate, and surrounding the stem or branch. *Branches* somewhat corymbose, each terminated by a rather large *flower*, with long white rays, and a prominent yellow disk. The late Mr. Crowe once found in Norfolk a partly double-flowered variety.

19. *P. maritimum*. Sea Feverfew. Sm. Fl. Brit. n. 3. Engl. Bot. t. 979. Willd. n. 18. Ait. n. 12. (*Matricaria maritima*; Linn. Sp. Pl. 1256. *Chamæmelum maritimum* perenne humiliss, foliis brevibus crassiss obscure virentibus; Dill. in Raii Syn. 186. t. 7. f. 1.)—Leaves doubly pinnate; segments linear, pointless, fleshy; convex above; keeled beneath. Stem diffuse. Seed-crown lobed.—Native of the sea-coast in the north of Europe. Found in several parts of Scotland, as well as on the south coast of England, and in Lancashire and Durham, flowering in July and August. The root is perennial. Stems numerous, prostrate, spreading circularly to the extent of two or three feet. The leaves are more fleshy than in the foregoing; the disk of the *flower* broader, in proportion to the length of the rays; and the crown of the *seed* divided into three or four lobes. The whole herb is slightly aromatic, and of a darker more shining green than *inodorum*.

20. *P. parviflorum*. Small-flowered Feverfew. Willd. n. 19.—“Leaves doubly pinnate; leaflets linear-thread-shaped, in two or three deep divisions. Stem erect, branched. Seed-crown two-lobed.”—Described by Willdenow from living specimens, but the native country of this species is unknown. It is said to be annual, greatly resembling *P. inodorum*, but having a taller and upright stem; a shorter radius; and a green two-lobed crown to the *seed*.

Section 2. *Radius yellow*.

21. *P. multicaule*. Many-stalked yellow Feverfew. Willd. n. 20. (*Chrysanthemum multicaule*; Desfont. Atlant. v. 2. 282. t. 236.)—Leaves simple, smooth, spatulate; the lower ones toothed. Stem erect, much branched from the bottom.—Native of sandy hills near Mascara, in Barbary. Root fibrous, apparently annual. Stem branched from the base principally, bushy; the branches naked above, each bearing a solitary *flower*, about as big as a French Marygold, whose radiant *florets* are yellow, and of a very broad elliptical form, about eight or nine or number.

22. *P. trifurcatum*. Three-forked Yellow Feverfew. Willd. n. 21. (*Chrysanthemum trifurcatum*; Desfont. Atlant. v. 2. 281. t. 235. f. 2.)—Leaves fleshy, smooth, linear, acute; the lowermost pinnate; the uppermost undivided. Stem ascending, single-flowered.—Native of fields near Kerwan in Barbary, flowering in winter. The stem is simple, a foot high; leafy below; naked above; terminated by a very large *flower*, with numerous yellow radiant *florets*. Some leaves are partly bipinnate; others three-cleft; the uppermost simple; all linear, wavy, acute, and of equal breadth.

23. *P. Bocconi*. Dwarf Pale-yellow Feverfew. Willd. n. 22. (*Chrysanthemum aragonense*; Affo Synops. n. 845. t. 9. f. 1. Willd. Bellis incana, chrysanthemi cretici folio; Bocc. Mus. 136. t. 98.)—Leaves hoary, stalked, pinnate; leaflets linear-awl-shaped: upper ones linear, undivided, and entire. Stems single-flowered.—Native of Spain and Sicily. Willdenow describes it thus from dried specimens. “Root many-headed, woody. Stems several, simple, a span high, single-flowered. Leaves hoary; the radical ones stalked, oblong, fading when arrived at maturity, and altogether wanting when the *flowers* open; lower stem-leaves stalked, pinnate at the extremity, with three or four pair of very short linear-awl-shaped leaflets, and a membranous

linear footstalk; the upper ones linear, sessile, and entire. Rays of the *corolla* pale yellow. It resembles *Chrysanthemum pectinatum*, but differs abundantly in the *calyx* not being membranous, and in having a crown to the *seed*.”

We know nothing of Affo's plant. Willdenow cites an additional synonym, Barrelier's t. 1153. f. 1, which seems to have no affinity to the figure of Bocccone, and much more resembles *Cineraria minuta*, Cavan. Ic. t. 33. f. 3, under which indeed Willdenow likewise quotes it, Sp. Pl. v. 3. 2086.

24. *P. orientale*. Oriental Yellow Feverfew. Willd. n. 23.—“Leaves doubly pinnate; leaflets linear. Stems ascending, single-flowered.”—Native of Georgia. Stems six inches high, naked above. Lower leaves an inch long; the upper ones half as long, and only simply pinnate. Scales of the *calyx* withered at the edge. Flowers deep yellow, the size of *Chrysanthemum segetum*. Willd.

25. *P. millefoliatum*. Milfoil-leaved Yellow Feverfew. Willd. n. 24. Ait. n. 13. (P. n. 174; Gmel. Sib. v. 2. 207. t. 86. f. 1, 2. *Chrysanthemum millefoliatum*; Linn. Syst. Veg. ed. 13. 643. *Anthemis millefolia*; Linn. Sp. Pl. 1263. *Achillea foliis pinnatis*, &c.; Mill. Ic. t. 9.)—Leaves doubly pinnatifid, linear, bluntish. Stem corymbose. Rays half as long as the diameter of the disk.—Native of Siberia. A hardy perennial, flowering throughout the summer. The stem is twelve or eighteen inches high, leafy, branched and corymbose, bearing eight or more long-stalked yellow *flowers*, whose disk is about half an inch in diameter, and their radiant *florets* of a short roundish figure, hardly extending a quarter of an inch from the disk. Seed-crown toothed. Leaves doubly and interruptedly pinnatifid, with linear, bluntish segments, each tipped with a minute point; their surfaces both downy, or somewhat silky. The leaves, as well as *flowers* and *seeds*, are very distinct from *Chrysanthemum italicum*, to which Linnæus compares this species.

26. *P. bipinnatum*. Wing-leaved Yellow Feverfew. Willd. n. 25. Ait. n. 14. (P. n. 172; Gmel. Sib. v. 2. 205. t. 85. f. 1. *Chrysanthemum bipinnatum*; Linn. Sp. Pl. 1255.)—Leaves doubly or triply pinnatifid; their segments dilated upwards, minutely pointed. Stem nearly simple. Rays wedge-shaped, not a quarter so long as the diameter of the disk.—Native of Siberia, flowering in June. Introduced at Kew by Mr. Bush, in 1796. This differs from the last in having more compound leaves, whose ultimate segments are almost elliptical, and all their points distinctly awned. But the *flowers* especially differ in being fewer, from one to three on each stem, and furnished with a disk near an inch wide, while their radiant marginal *florets* are short, broad, and wedge-shaped, with broad spreading teeth. The *calyx*, as well as all the herbage, is shaggy with soft hairs.

27. *P. indicum*. East Indian Yellow Feverfew. Sims in Curt. Mag. t. 1521. Ait. n. 15.—Leaves pinnatifid; their segments dilated upwards, lobed. Stem branched. Flowers on long stalks, nearly globular. Radiant *florets* few, very short.—Sent by Dr. Roxburgh, from the East Indies, to A. B. Lambert, esq. It proves a hardy annual in our gardens, flowering most part of the summer. The stem is much branched, but the pinnatifid, though more simple and broader, leaves, betray an affinity to the two last species, which is confirmed by the short yellow radiant *florets*. These however are, according to Dr. Sims, most generally wanting. The *flowers* are solitary, on long swelling furrowed stalks, terminating each branch; their disk nearly an inch wide, and finally convex. The herbage appears to be smooth.

28. *P. Myconi*. Tongue-leaved Yellow Feverfew. (*Chrysanthemum Myconi*; Dalech. Hist. 873. Linn. Sp. Pl. 1254. Willd. Sp. Pl. v. 3. 2148. Ait. Hort. Kew. v. 5. 96. Jacq. Obl. fasc. 4. 10. t. 94.)—Leaves tongue-shaped, obtuse, toothed, clasping the much-branched stem. Radiant florets numerous, roundish.—Native of fields in the south of Europe; a hardy annual with us, but preserved for the sake of variety, rather than ornament, the flowers being inferior in size and splendour to our wild *Chrysanthemum segetum*, while the leaves resemble those of *C. Leucanthemum*. The plant however is very different from both those, and a true *Pyrethrum*, akin to the last described, the seed having a very evident membranous crown, as Willdenow, copying Linnæus, mentions; yet he still left this species where he found it. Our predecessor, the excellent Mr. Wood, has corrected this error. (See *CHRYSANTHEMUM*, at the end.) We venture likewise to correct the specific name, which authors have copied incorrectly from Dalechamp. He calls the plant *Myconi*, after its discoverer Myconus. The stem is very much branched. Leaves simple, an inch and a half or two inches long, smooth. Flowers on long solitary stalks, at the ends of the branches, bright yellow, an inch wide; their radiant florets numerous, crowded, short, of a roundish or oblong shape. Seed-crown large, jagged, and fringed.

PYRETICS, formed from πυρετός, *fever*, of πυρ, *fire*, medicines good against fevers.

PYREXIA, in *Medicine*, from πυρετός, *fever*, a term used by Dr. Cullen to signify feverish action generally, whether idiopathic or sympathetic. The same writer also used the term as the denomination of his first class of diseases, including fevers and inflammations. See his Nosol. Method. class 1, *Pyrexia*.

PYRGI, or **PYRGOS**, in *Ancient Geography*, a town of Italy, upon the coast of Etruria; placed by Ptolemy between Castrum Novum and Alsum, and said by Livy to have been a Roman colony.—Also, a town of the Peloponnesus, in Messenia.

PYRGO, in *Geography*, a sea-port town on the S.E. coast of the island of Santoria. N. lat. 36° 26'. E. long. 25° 38'.

PYRGUS, among the Romans, a dice-box of the shape of a modius, open above, and having a great many shelves or partitions within it; so that when the dice were thrown into it out of the fritillum, they were thereby overturned many times before they could reach the bottom, in which there was an opening for them to fall through upon the table.

PYRGUS, in *Botany*, a genus of Loureiro's, Fl. Cochinch. 120, which Mr. Brown, Prodr. Nov. Holl. v. 1. 533, reduces to *ARDISIA*, see that article. The name is taken from πυργός, *a turret*, alluding to the conical shape assumed by the converging stamens.

PYRHOPOECILOS, in the *Natural History of the Ancients, a stone so called from its having a great many spots of the colour of fire.*

PYRIATERION, a word used by the ancients to express a sweating room.

PYRIATOS, a word used by some authors to express a brick when heated, in order to be applied to the body wrapped up in a cloth by way of a dry fomentation.

PYRICAUSTUM, a word used by medical writers to express a burn or scald.

PYRICUBIUM, in *Natural History*, the name of a genus of fossil bodies, usually comprehended, with many others of very different figure and structure, under the general name *pyrites*.

The distinguishing characters of the pyricubia are these; they are compound, inflammable metallic bodies, of a cubic figure, or resembling a die, being composed of six sides. Of this genus there are only two known species. Hill.

PYRIFORMIS, in *Anatomy*, a muscle of the thigh, flattened and triangular in its figure, situated at the back of the pelvis, and extending from the sacrum to the great trochanter. The posterior surface is covered by the gluteus magnus, and partly by the medius. The anterior is partly in the pelvis, partly on the outside of the cavity. Within the pelvis it corresponds to the rectum, the sciatic plexus, and the hypogastric vessels: externally to the cavity it covers the gluteus minimus, the os innominatum, and the capsule of the hip. The upper edge corresponds to the sciatic notch, and the gluteal artery; it then lies close to the gluteus medius. The inferior edge corresponds to the lesser sacro-sciatic ligament, and then is parallel to the geminus superior: it is at first separated from the latter muscle by the great sciatic nerve, and afterwards approaches to, and is united with it.

The basis of the pyriformis is attached to the side of the anterior surface of the sacrum, in the intervals of the sacral foramina, to these foramina at their outer parts, to the anterior surface of the great sacro-sciatic ligament, and to the posterior and upper part of the os innominatum. The muscle proceeds from within outwards, and rather downwards, passes out of the pelvis at the great sacro-sciatic foramen, gradually diminishes, and terminates in a small tendon, fixed to the upper part of the internal surface of the great trochanter.

The attachment of this muscle to the great trochanter is by means of a tendon, the lower edge of which is connected to that of the superior geminus. This tendon expands into an aponeurosis, which, after extending on the front of the muscle, enters into its substance. The fleshy fibres arise from the parts mentioned above; and are fixed in all directions to the tendon. Sometimes a portion of the sciatic nerve passes through a slit in the muscle.

When the thigh is extended, the pyriformis will rotate it outwards; but when it is bent, it will act as an abductor. If the thigh is fixed, it will move the pelvis in an opposite direction.

PYRIPHLEGES, a word used by the old writers in medicine to express a person labouring under an extreme degree of a febrile heat.

PYRIPLACIS, in *Natural History*, the name of a genus of pyrites, the characters of which are these: they are compound, inflammable, metallic bodies, found in loose detached masses of a simple and uniform, not striated internal structure, and are covered with an investment coat or crust.

Of this genus of fossils there are three known species. Hill.

PYRIPOLYGONIUM, the name of a genus of fossils, the characters of which are, that they are compound metallic bodies, of a regular figure, consisting of twelve planes.

There is only one known species of this genus, though subject to great varieties in its appearance; and this has been by authors hitherto confounded with many other bodies of a very different nature and figure, under the general name *pyrites*.

It is not unfrequent in Cornwall and Devonshire; but is much more common in Germany. Hill.

PYRITES, *Sulfure metallique*, in *Mineralogy* and *Chemistry*, a name given to certain ores which contain a large quantity of sulphur, and have a metallic lustre. The Greek

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word *πυρίτης*, formed of *πυρ*, *fire*, denotes fire-stone; a denomination given to this substance on account of its inflammability. For the mineralogical characters of copper pyrites, and iron pyrites, see *COPPER Ore*, and *IRON Ore*.

Besides these there are arsenical pyrites, auriferous pyrites, and tin pyrites. Combinations of sulphur with the metals are called by chemists sulphurets; and the different kinds of pyrites are properly metallic sulphurets. Sulphur has a great affinity for iron, and in combination with this metal, under the form of pyrites, exists in extensive beds in primary mountains, or is disseminated through the secondary rocks and strata, in veins and masses, or variously crystallized: it occurs also in beds of coal and bituminous clay. Iron pyrites may be considered, after the earths, as one of the most abundant substances in the mineral kingdom, forming a constituent part of the globe, and by its decomposition giving rise to many important subterranean phenomena.

The proportions of iron and sulphur in the different species of iron pyrites enumerated by mineralogists are,

52 to 54 Sulphur
48 to 56 Iron.

Magnetic pyrites differs from common pyrites: its constituent parts, according to Mr. Hatchett, are,

36.50 Sulphur
63.50 Iron.

By the application of heat common pyrites becomes susceptible of attraction by the magnet; the excess of sulphur being expelled. Iron pyrites is not worked as an ore of iron, but is principally valued for the green vitriol or sulphate of iron, which it affords when exposed to air and moisture. Sulphur may also be obtained from pyrites when heated with charcoal.

The decomposition of pyrites is effected spontaneously by the absorption of oxygen from water and the atmosphere, which converts the sulphur into sulphuric acid, and the iron into an oxyd. These substances unite during the process, and form the sulphate of iron, or green vitriol.

Some kinds of pyrites are rapidly decomposed, others require to have part of the sulphur expelled by heat. The pyrites, or pyritous substance intended to form vitriol, is collected in extensive heaps, spreading the surface as much as can be conveniently done. The ground on which these heaps are spread should be impervious to water, and inclined, in order that the saline matter which effloresces may be washed off, and conveyed into reservoirs to crystallize. As the decomposition proceeds the mass becomes heated, and is occasionally moistened, particularly when the air is dry and warm. These beds continue productive for many years, and if the pyrites be pure, but little residuum is left. An excess of sulphuric acid is formed during the process, on which account a quantity of old iron is added to the solution, to saturate it, and obtain the salt in a crystallized state. During the decomposition of pyrites much heat is evolved, and a considerable absorption of oxygen from the atmosphere takes place. The fact was first observed by Henckel, who affirmed, in his "Pyritologia," that air was necessary to the process of vitrification, and that it enters into combination with pyrites and remains fixed in it: "non ut instrumentum transiens sed immanens." This may be considered as a happy anticipation of one of the most important doctrines of modern chemistry. Some geologists have supposed that subterranean fires, and the temperature of hot springs, are occasioned by the spontaneous decomposition of immense beds of pyrites in the interior of the earth, and an experiment made by Lemery gives some plausibility to this opinion. He found that a

mixture of iron filings and sulphur, moistened with a small quantity of water, becomes hot in a few hours, the mass swells, and the parts adhere together: it then breaks with a perceptible noise and crackling, and emits aqueous vapour, and a fetid odour like that of sulphurated hydrogen gas. If the mixture be made in a large quantity, it takes fire in twenty-four or thirty hours. As soon as the emission of aqueous vapour has ceased, the heat becomes greater and greater, is succeeded by inflammation, the smell is then much stronger, and appears to arise from the hydrogen produced by the decomposition of water. Beaumé, who observed this phenomenon from a mixture of one hundred pounds of iron filings, with an equal quantity of sulphur in powder, states that the flames rose to a foot in height, but did not continue longer than two or three minutes; the mass, however, remained red-hot for forty hours. Lemery the elder gave to this experiment the name of the artificial volcano.

Dr. Watson, in his *Chemical Essays*, vol. i. p. 187, says that he has repeated this experiment more than once. When made in the open air the flame is of short duration, and the whole mass, after the extinction of the flame, continues at intervals to throw out sparks. A ladle full of the ignited mass being dropped down from a considerable height, descended like a shower of red-hot ashes. The success of this experiment depends on a due proportion of water. Half a pound of flower of sulphur, with half a pound of clean iron filings, mixed with fourteen ounces of water, and worked into a paste, will acquire heat enough to make the mass take fire.

Some dark-coloured carbonaceous and bituminous earths contain pyrites in minute grains, and decompose with great rapidity when exposed to moisture. In the month of August 1751, the cliffs near Charmouth, in Dorsetshire, containing a similar kind of pyritous earth, took fire in consequence of a heavy fall of rain after a hot dry season, and continued at intervals to emit flame for several years. Almost all kinds of pit-coal in England contain more or less pyrites: in some the quantity is very inconsiderable, in other kinds it abounds so much as to render them unfit for domestic purposes, and totally inapplicable for forges or iron works, on account of the sulphur which they emit when burned. This pyritous coal may be distinguished by its greater specific gravity, and the brass-like metallic appearance of the pyrites with which it is intermixed. Pyritous coal and coal shale, or bituminous clay, containing pyrites, frequently take fire spontaneously in coal mines, or when exposed in heaps out of the pits, and continue burning many years. Instances of this kind now exist in the north of England; and so intense is the heat produced by the ignition of these masses, that the coal shale is sometimes fused. We have seen specimens from these heaps which have all the characters of cellular volcanic lava. In the vicinity of Leeds there is a large heap of coal shale which has been on fire near half a century; it is covered in parts with vegetation, and presents no appearance of ignition during the day; but if a dry stick be thrust into it the surface is changed in a few minutes. In some of the coal mines in Leicestershire, near Ashby de la Zouch, the stratum of indurated clay over the main bed of coal contains so much pyritous matter, and is so subject to spontaneous inflammation when it falls down and is intermixed with small coal and moisture, that the miners are obliged to close up the space with brick-clay where the coal has been worked, to prevent the access of air to the combustible matter. In this state, excluded from the air, the pyritous earth sometimes becomes ignited, as is evident by the heat communicated to the neighbouring parts of the mine; but the fire is prevented from spreading among the

coal,

goal, by the precautionary measure of closing the cavities with clay.

The great heat evolved during the decomposition of pyrites, may proceed in part from the combination of oxygen with the sulphur and iron, and may be increased by the different capacity of the new compound for heat. Whenever chemical changes take place rapidly, they produce a change in the temperature of substances, as in the well-known instances of lime and water, nitric acid and vegetable oils, &c.

The phenomena accompanying the mud volcanoes in various parts of the world, present many appearances which give probability to the opinion, that they proceed from the decomposition of pyritic strata. See *VOLCANO*.

The formation of alum is also effected naturally, in many situations, by the decomposition of pyrites, the sulphuric acid combining with the alumine of pyritous clay. This is not unfrequently the case in excavations of coal mines that have been long worked out.

At Hartlet, near Glasgow, in the excavations of an old coal mine that has been worked some centuries, there is a very extensive formation of alum, from the decomposition of the roof of the pit. It is a pyritous clay ten inches thick. In the old workings of the mine which are dry the air circulates slowly, and the roof gradually decomposes and exfoliates, and falls upon the floor, in which situation the decomposition proceeds, and the substance assumes the appearance of a spicular efflorescence. In time the whole space to the roof is filled; it is then removed. The mass consists of earth richly impregnated with sulphate of alumine, sulphate of iron, and in some instances with sulphate of magnesia. The coal in this mine, contrary to the usual practice, is worked to the dip, so that the old workings are always dry. To this circumstance may principally be attributed the great accumulation of alum in this mine. In many of the mines in England a similar formation of alum would take place, but they contain too much water to permit the saline substances to remain. In general, alum rock or alum shale require to be exposed in heaps, and burned in the open air, to expel the sulphur, and combine it with the oxygen from the atmosphere. The sulphuric acid thus formed unites with a requisite portion of the clay during the process.

The gypsum, or the sulphate of lime which occurs in beds, among secondary strata of red sand-stone and beds of marle, probably may owe its present state to masses of pyrites, which have existed over common lime-stone, and been decomposed naturally. The sulphuric acid thus produced would unite with the lime, and form gypsum. The great quantity of the red oxyd of iron which is in the stone and marle that accompany this kind of gypsum, gives much probability to this opinion. The crystals of gypsum or selenite found detached in beds of clay had probably a similar origin.

Sulphuret of iron may be formed by heating together iron filings and sulphur. From the experiments of Vauquelin it is proved that there are four sulphurets of iron, according to the degree of heat and other circumstances under which the combination may be formed. The first sulphuret consists of

78 Iron } Artificial.
22 Sulphur }

The second sulphuret, of

64 Iron } Natural magnetic pyrites.
36 Sulphur }

The third sulphuret, of

54.16 Iron } Artificial.
45.84 Sulphur }

The fourth sulphuret, of

47 Iron } Natural common pyrites.
33 Sulphur }

When the quantity of sulphur does not exceed 40 per cent. pyrites is soluble in muriatic acid, and may be rendered permanently magnetic. The specific gravity of common pyrites is from 4.60 to 4.83. Of magnetic pyrites 4.51.

Arsenical pyrites, called marcasite, is distinguished from iron pyrites by its colour, which is a silver white, and by yielding a smell like garlic when rubbed or exposed to heat. See *ARSENIC Ores*.

Auriferous pyrites, or iron pyrites, with a small alloy of gold: the richest specimens of this ore in Europe are found in Transylvania, containing from 0.02 to 0.03 of gold. These ores are distinguished from iron and copper pyrites by their colour, malleability, and specific gravity.

Tin pyrites. See *TIN Ore*.

The pyrites, in substance, are never used medicinally; nevertheless, in their products they are very important. From these common sulphur is extracted, in Sweden and Saxony; the native vitriols are produced in caverns of the earth, or on its surface; the greatest quantities of artificial vitriol are prepared; and the mineral waters, vitriolic, aluminous, sulphureous, hot or cold, are supposed to receive their impregnation.

When the matter of the pyrites is mixed with the lead ores, the method of separating the metal by assaying is this: roast two centners of the ore, as in the usual method, and keep a stronger fire than when the ore is pure. The pyrites, especially when it is merely iron, hinders ore from easily growing clammy or turning into large lumps, or entirely melting. When the ore is sufficiently washed, let it cool, beat it to powder, and repeat the roasting to a third fire, till when it is red-hot in the fire, there is no smell of sulphur; then mix the ore with six centners of the black flux, and two of sandiver, and finish the work in the common way, only making the fire greater, and continuing it longer, toward the end of the operation. Cramer's Art of Assaying, p. 292. See *LEAD Ore*.

PYRITES is applied by some authors to the marcasite ores of all metals; the names of which are varied according to the metals they partake of.

Thus *chrysis* is that of gold; *argyritis* that of silver; *fideritis* that of iron; *chalcitis* that of copper; and *molybditis* that of lead, &c.

PYRITICUM LIQUAMEN. See *LIQUAMEN Pyriticum*.

PYRITRICHIPHYLLUM, in *Natural History*, the name of a genus of fossils of the class of the pyrites, the characters of which are these: they are compound, inflammable, metallic bodies, found in loose masses not of any regularly angular figure, and of a striated texture, with foliaceous ends to the stræ, appearing on the surface, or within the mass.

Of this genus there are only two known species: one having the foliaceous ends of the stræ on the outer surface of the mass; and the other having a smooth external surface, and the foliaceous ends of the stræ covering the sides of internal hollows.

The first of these is found in many of the English and German mines; the other has been yet only found in the mines on Mendip hills in Somersetshire, but there in considerable plenty. Hill.

PYRITRICHUM, the name of a genus of pyrites, the characters of which are these: they are compound, inflammable, metallic fossils, always found in detached masses of

no regularly angular figure, and of a simply striated internal structure.

Of this genus of pyritæ there are three known species. All the three species are found plentifully in different parts of the kingdom: the first in all sorts of strata, and often loose on the ground; the second principally in the chalk-pits of Kent and Suffex; and the last in Effex and Hamp-shire, and very frequently in the German mines. Hill.

PYRITZ, in *Geography*. See PIRITZ.

PYRMONT, a town of Germany, and capital of the country so named; its citadel is fortified with a broad ditch, high ramparts, and subterraneous passages and vaults; 12 miles S.W. of Hamala. N. lat. $51^{\circ} 57'$. E. long. $9^{\circ} 17'$.—Also, a county and principality of Germany, bounded on the N. by the principality of Calenberg, on the E. by Wolfenbüttele and Calenberg, on the S. by Wolfenbüttele, and on the W. by the county of Lippe; about nine miles long, and three broad. The revenues are estimated at 30,000 rix-dollars, principally arising from the springs and salt-works.

PYRMONT Water, in *Physiology and Medicine*, a very brisk, spirituous chalybeate, abounding in fixed air, and which, when taken up from the fountain at Pyrmont, in Germany, whence its name, sparkles like the briskest Champagne wine. It has a pleasant, vinous taste, and somewhat sulphureous smell. It is perfectly clear, and bears carriage better than the Spa water.

The history of these waters is accurately given by Hoffmann in his observations on them, both in their natural state, and in mixture with other bodies.

He first observes, that they contain a volatile and subtle principle, much more penetrating and strong, as well as in larger quantity, than any other mineral water; but that this is not to be expected in them any where but upon the spot, for those who transport them to other places are constrained to let a part of this fly off, to preserve the rest. If either glass or earthen vessels be filled at the spring, and immediately corked and fastened down, the consequence is, that they will burst on the first motion, or heat of the weather. They are, therefore, forced to fill them only in part at first, and let them stand awhile for this subtle spirit to exhale; and then awhile after the filling them up, to cork and fit them for carriage.

2. If they are drank upon the spot in a morning, on an empty stomach, they affect the nose with a pungent tingling, and disturb the head for many hours afterwards.

3. If they are taken at the spring, they purge but very little; but if taken in another place, after transportation, they purge considerably more, and render the stools black. It is observable also, that if they are left in an open vessel a few days, their virtue wholly exhales, and they no longer purge nor render the stools black.

4. If tea-leaves, baulustine-flowers, or galls, are put into this water, they first change it to a blue, from that to a purple, and finally to a black. This is a ready proof that black is only a deep purple, and purple only a deep blue: a little spirit of vitriol added to this liquor destroys all the colour, and renders it limpid as before.

5. If any acid be mixed with Pyrmont water, there is raised an effervescence, and bubbles of air are carried up in great quantity; and this whether the stronger acids, such as spirit of vitriol, or aqua fortis, be used; or the weaker, as vinegar, lemon juice, or Rhenish wine.

6. If an alkaline liquor be added, whether it be volatile, as the spirit of sal ammoniac, or fixed, as the oil of tartar,

there is no ebullition raised, but the liquor becomes turbid and milky. If spirit of vitriol be afterwards added to this, to saturate the additional alkali, the liquor becomes limpid again.

7. Cow's milk mixed in equal quantity with Pyrmont water does not coagulate, but, on the contrary, becomes thinner than before, and is preserved from turning sour so soon as it otherwise would in hot weather. This is a proof that there is no predominating acid in these waters.

8. If syrup of violets be added to Pyrmont water, it turns it to a beautiful green. This is a proof of the alkaline nature of these waters; and it is further proved, by adding spirit of vitriol, or any other acid, to this green liquor, which on that becomes limpid again.

9. Four pints of this water evaporated over a gentle fire, yield no more than two scruples of a dry residuum. Oil of vitriol being poured on this, an acid effervescence arises, and with it an acrid and pungent vapour, like that produced by mixing oil of vitriol and common salt. If spirit of vitriol be used instead of the oil, the effervescence is in a less degree, and the salt is in part changed to a bitter saline mass, the remainder separated from which proves to be a calcareous earth, no longer fermenting with the spirit of vitriol.

10. If a quantity of Pyrmont water be exposed twenty-four hours to the open air in a basin, it will at the end be found to have lost all its virtues, tasting wholly insipid, and being turbid, instead of the fine clearness it had before, and a yellow ochreous earth is precipitated to the bottom: after this the liquor will no longer shew any of those qualities, which were before its distinguishing characters; it will no longer ferment with acids, nor turn black with galls, nor green with syrup of violets.

It appears from the whole, that the Pyrmont waters possess a pure, extremely penetrating, and elastic mineral spirit, and that in a very large proportion; and to this their virtues are principally to be attributed. This mineral spirit, while it remains engaged in a calcareous earth, imitates the properties of an alkaline substance; and when joined with a subtle martial earth, it emulates the properties of vitriol, giving the stools a black colour, and turning a tincture of galls into ink: and while this remains in the water in these forms of an alkaline or vitriolic principle of so great subtilty, it cannot but give them very great virtues in strengthening the tone of the viscera, opening obstructions, and stimulating in a proper manner the excretory ducts, so as to make them duly perform their office; but as soon as by the standing of the water open, or by any other accident, this subtle element is evaporated, all the virtues of the water must be gone with it.

The great quantity of this powerful spirit contained in the waters, makes them more fit for the robust and strong constitutions, when depraved by illness, than for the weak and tender ones; but even the tenderest people may take them, only observing to take but a small dose, or to dilute them with an equal quantity of common water immediately before the taking them.

Hoffmann also recommends the Pyrmont water mixed with equal quantities of milk, on his own experience, in scorbutic and gouty cases. Hoffm. Oper. tom. v. p. 143, seq.

We have already observed, under the articles ACIDULÆ and CARBONIC Acid, that Pyrmont water, and other mineral waters of a similar nature, owe their acidulous taste and peculiar virtues to the fixed AIR (carbonic acid) which they contain; and to those articles the reader is referred for a brief history

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of this important discovery. We shall here add some farther remarks on the effects and medical uses of this water.

Persons who drink it at the well are affected with a kind of giddiness or intoxication, which is probably owing to the great quantity of carbonic acid with which the water abounds. The common operation of this water is by urine; but it is also a gentle sudorific; and if taken in large quantity, proves laxative. However, in order to this effect, it is usual to mix some salts with the first glasses. It is drunk by glasses in the morning, to the quantity of from one to five or six pints, according to circumstances; those who drink it walking about between each glass. This water is recommended in cases where the constitution is relaxed; in want of appetite and digestion; weakness of the stomach, and heartburn; the green sickness; female obstructions and barrenness; the scurvy, and cutaneous diseases; and in the gout, especially, as Hoffmann observes, when mixed with milk; in colics; bloody fluxes; disorders of the breast and lungs; in which case it is best taken lukewarm: in nervous, hysterical, and hypochondriacal disorders; in apoplexies and palsies; in the gravel and urinary obstructions; in foulness of the blood; and in obstructions of the finer vessels. It amends the lax tenure of the blood; exhilarates the spirits without inflaming, as vinous liquors are apt to do; and is reckoned among the best restoratives in decayed and broken constitutions. It is said to possess the general virtues of the Spa water, and at the fountain it is more spirituous, as well as a stronger chalybeate. Elliot's Medicinal Virtues, &c. of Mineral Waters, 1781, p. 181.

Near the famous well at Pyrmont is a stone quarry under ground, from some parts in which a sulphureous steam comes out, which commonly rises to a small height. Animals held in this steam are soon suffocated, but recover, if quickly taken out. When a man stands in this steam, but with his head over it, it proves an excellent sudorific. Dr. Seip proposes to perform cures in several diseases with it. See Phil. Trans. N^o 448, sect. 4, and Misc. Berlin. tom. v. part 2. sect. 4. See *Grotta del Serpi*.

PYRMONT Water, Imitation of. This medicinal water may be imitated very nicely by art in the following manner: take a quart of the purest and lightest water, add to it thirty drops of a strong solution of iron made in spirit of salt, a drachm of oil of tartar per deliquium, and thirty drops of spirit of vitriol, or a little more or less, as is found necessary, not to let the alkali of the oil of tartar prevail too strongly, though it must prevail a little. Shake all briskly together, and on tasting it will be found extremely to resemble the true Pyrmont water.

The basis on which this is founded is the analysis and trial of the true Pyrmont water, by which it is found to contain a subtile aqueous fluid, a volatile iron, and a predominant alkali, all joined together into one brisk pungent spirituous water. The artificial Pyrmont thus made, if the proportions are carefully minded, will extremely resemble the natural, and will have the same effect as a medicine. Shaw's Lectures, p. 90.

But the best method of forming artificial Pyrmont water is by impregnating it with fixed air, or carbonic acid, for which we are indebted to Dr. Priestley. The first person, we believe, who actually compounded an artificial acidulous or spirituous water, like that of Seltzer or Pyrmont, was M. Venel; though he was ignorant of the real nature of the ingredient to which it owed these qualities, and which he erroneously supposed to be common air. For this purpose he dissolved in a pint of water two drachms of fossil alkali, to which he added an equal quantity of marine acid: in the process he made use of a vessel with a narrow neck, and to prevent the escape of the

air, he disposed the ingredients in such a manner, that they could not communicate with each other till after the bottle was corked. In this case the fixed air dislodged from the alkaline salt, in a phial nearly full and closely corked, being confined, suffers a degree of compression that greatly promotes its combination with the water. See *Memoires presentés par les Sçavans Etrangers*, tom. ii. containing two *Memoirs of M. Venel*, read before the Royal Academy of Sciences in 1750; and *Laviosier's Essays*, &c. by Henry, p. 34, &c. However, Dr. Priestley was undoubtedly the first who so far improved upon the discoveries made by himself and others in relation to the principle then denominated fixed air, as to contrive an easy method of impregnating water with it. The first idea of this kind occurred to him in 1767, when, having placed shallow vessels of water within the region of fixed air on the surface of the fermenting vessels of a brewery, and left them all night in that situation, he found that the water had acquired a very sensible and pleasant impregnation. He proceeded to accelerate the impregnation by pouring the water from one vessel into another, while they were both held within the sphere of the fixed air. The method of effecting this by air dislodged from chalk and other calcareous substances, did not occur to him till the year 1772, when he published his directions for this purpose, together with a drawing of the necessary apparatus, which he had before communicated to the Board of Admiralty. This apparatus, represented in *Plate XV. Pneumatics*, fig. 1, consists of a glass vessel, *a*, with a narrow neck, and so formed, that it will stand upright, with its mouth downwards: this vessel, when filled with water, and covered with a slip of paper or thin pasteboard, pressed close to it, to prevent the admission of common air, is inverted in another vessel, *b*, with a little water in it, so that the slip of paper or pasteboard may be withdrawn, and the end of the pipe, *c*, introduced into it. This pipe is flexible and air-tight, and best made of leather, sewed with a shoemaker's waxed thread. It is kept open at both ends by a piece of a quill, while one of them is introduced into the vessel of water, and the other into the bladder *d*; the opposite end of which is tied round a perforated cork, kept open by a quill, and the cork is made to fit a phial, *e*, two-thirds of which should be filled with chalk just covered with water. Dr. Priestley has since found it most convenient to use a glass tube; and to preserve the advantage which he had of agitating the vessel *e*, he makes use of two bladders, communicating by a perforated cork, to which they are both tied. He also observes, that the flexible pipe is not necessary; but instead of this a bent tube of glass must be ready to be inserted into the hole made in the cork, when the bladder containing the fixed air is separated from the phial in which it was generated. The extremity of this tube being put under the vessel of water, and the bladder being compressed, the air will be conveyed into it, as in the other case. Instead of the bladder, a small phial may be interposed between the phial containing the chalk, &c. and the vessel of water: for thus the chalk and water that may be thrown up the tube communicating with this phial will lodge at the bottom of the other, while nothing but the air will get into the pipe communicating with the water. The apparatus being thus prepared, let the phial containing the chalk and water be detached from the bladder, and the pipe also from the vessel of water; pour a little oil of vitriol upon the chalk and water; and having carefully pressed all the common air out of the bladder, put the cork into the bottle presently after the effervescence has begun. Also press the bladder once more after a little of the newly-generated air has got into it, in order the more effectually to clear it of all the remains of the common air; and then introduce

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Introduce the end of the pipe into the mouth of the vessel of water, as in the drawing, and begin to agitate the chalk and water briskly. This will presently produce a considerable quantity of fixed air, which will distend the bladder; and this being pressed, the air will force its way through the pipe, and ascend into the vessel of water, the water at the same time descending, and coming into the basin.

When about one-half of the water is forced out, let the operator lay his hand upon the uppermost part of the vessel, and shake it as briskly as he can, not to throw the water out of the basin; and in a few minutes the water will absorb the air, and taking its place, will nearly fill the vessel as at the first. Then shake the phial containing the chalk and water again, and force more air into the vessel, till, upon the whole, about an equal bulk of air has been thrown into it. Also shake the water as before, till no more of the air can be imbibed. As soon as this is perceived to be the case, the water is ready for use; and if it be not used immediately, should be put into a bottle as soon as possible, well corked, and cemented. It will keep, however, very well, if the bottle be only well corked, and kept with the mouth downwards.

It may be proper to observe on this process, that the phial, *c*, should always be placed considerably lower than the vessel *a*; that the water to which the chalk is put should be changed after every operation; that with a vessel of water holding three pints, and a phial containing the chalk and water of ten ounces, a little more than a tea-spoonful of oil of vitriol will produce air enough to impregnate such a quantity of water, that the whole process does not take up more than a quarter of an hour, and the agitation not five minutes; and that in this method the water is easily made to imbibe an equal bulk of air; whereas Dr. Brownrigg found that Pyrmont water at the spring-head did not contain so much as one-half. This apparatus has received considerable improvements, which we shall briefly recite; but in justice to the merit of the original inventor, his method deserves to be recorded; and besides, it requires less time, and is much less expensive than those that are now generally used.

The apparatus contrived by Dr. Nooth, and improved by Mr. Parker, is represented in *fig. 2*. It is made of glass, and stands on a wooden vessel, *d d*, resembling a tea-board; the middle vessel *B* has a neck, which is inserted into the mouth of the vessel *A*, to which it is ground air-tight. This lower neck of the vessel *B* has a glass stopple *S*, composed of two parts, both having holes sufficient to let a good quantity of air pass through them. Between these two parts is left a small space, containing a plano-convex lens, which acts like a valve, in letting the air pass from below upwards, and hindering its return into the vessel *A*. The upper vessel *C* terminates below in a tube *rt*, which, being crooked, hinders the immediate ascent to the bubbles of fixed air into that vessel, before they reach the surface of the water in the vessel *B*. The vessel *C* is also ground air-tight to the upper neck of the middle vessel *B*, and has a stopple, *p*, fitted to its upper mouth, which has a hole through its middle. The upper vessel *B* holds just half as much as the middle one *B*; and the end, *t*, of the crooked tube goes no lower than the middle of the vessel *B*.

For the use of this apparatus, fill the middle vessel *B* with spring or any other wholesome water, and join to it the vessel *C*. Pour water into the vessel *A* (by the opening *m*, or otherwise) so as to cover the rising part of its bottom: about three-fourths of a pint will be sufficient. Fill an ounce phial with oil of vitriol, and add it to the water, shaking the vessel so as to mix them well together. As heat is gene-

rated, it will be best to add the oil by a little at a time, otherwise the vessel may be broke. Put to this, through a wide glass or paper funnel, about an ounce of powdered raw chalk, or marble. White marble being first granulated, or pounded like coarse sand, is better for the purpose than powdered chalk, because it is harder; and, therefore, the action of the diluted acid upon it is slower, and lasts a considerable time. On this account the supply of fixed air from it is more regular than with the chalk: and besides, when no more air is produced, the water may be decanted from the vessel *A*, and the white sediment washed off, and the remaining granulated marble may be employed again, by adding to it fresh water and a new quantity of oil of vitriol. The funnel in this process is made use of in order to prevent the powder from touching the inside of the vessel's mouth: for if that happens, it will stick so strongly to the neck of the vessel *B*, as not to admit of their being separated without breaking. Place immediately the two vessels *B* and *C* (fastened to each other) into the mouth of the vessel *A*, as in the figure, and all the fixed air which is disengaged from the chalk or marble by the oil of vitriol, will pass up through the valve in *S* into this vessel *B*. When this fixed air comes to the top of the vessel *B*, it will dislodge from thence as much water as is equal to its bulk: which water will be forced up through the crooked tube into the upper vessel *C*.

Care must be taken not to shake the vessel *A* when the powdered chalk is put in; otherwise a great and sudden effervescence will ensue, which will perhaps expel part of the contents. In such case it may be necessary to open a little the stopple *p*, in order to give vent, otherwise the vessel *A* may burst. It will be proper also to throw away the contents, and wash the vessel; for the matter will stick between the necks of the vessels, and cement them together. The operation must then be begun afresh. But if the chalk be thrown in without shaking the machine, or if marble be used, the effervescence will not be violent. If the chalk be put into the vessel loosely wrapped up in paper, this accident will be still better guarded against. When the effervescence goes on well, the vessel *C* will soon be filled with water, and the vessel *B* half filled with air; which will easily be known to be the case, by the air going up in large bubbles through the crooked tube *rt*.

When this is observed, take off the two vessels *B* and *C* together as they are, and shake them so that the water and air within them may be much agitated. A great part of the fixed air will be absorbed into the water; as will appear by the end of the crooked tube being considerably under the surface of the water in the vessel. The shaking them for two or three minutes will be sufficient for this purpose. These vessels must not be shook while joined to the under one *A*, otherwise too great an effervescence will be occasioned in the latter; together with the ill consequences above-mentioned. After the water and air have been sufficiently agitated, loosen the upper vessel *C*, so that the remaining water may fall down into *B*, and the unabsorbed air pass out. Put these vessels together, and replace them into the mouth of *A*, in order that *B* may be again half filled with fixed air. Shake the vessels *B* and *C*, and let out the unabsorbed air as before. By repeating the operation three or four times, the water will be sufficiently impregnated.

Whenever the effervescence nearly ceases in the vessel *A*, it may be renewed by giving it a gentle shake, so that the powdered chalk or marble at the bottom may be mixed with the oil of vitriol and water above it; for then a greater quantity of fixed air will be disengaged.

When the effervescence can be no longer renewed by shaking the vessel *A*, either more chalk must be put in, or more

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more oil of vitriol; or more water, if neither of these produce the desired effects.

The ingenious Mr. Magellan has still farther improved the contrivance of Dr. Nooth and Mr. Parker; he has two sets of the vessels B and C. While he is shaking the air and water contained in one of these sets, the other may be receiving fixed air from the vessel A. By this means twice the quantity of water may be impregnated in the same time. He has a wooden stand K (*fig. 3.*) to fix the vessels B, C on, when taken off from A, which is very convenient. He has a small tin trough for measuring the quantity of chalk or marble requisite for one operation, and a wide glass funnel for putting it through into the vessel A, to prevent its sticking to the sides, as mentioned before.

He has also contrived a stopple without a hole, to be used occasionally, instead of the perforated one *p*. It has a kind of bason at the top, to hold an additional weight when necessary. (See *fig. 4.*) The stopple must be of a conical figure, and very loose; but so exactly and smoothly ground as to be air-tight merely by its pressure, which may be increased by additional weights put into its bason. Its use is to compress the fixed air on the water, and thereby increase the impregnation: for by keeping the air on the water in this compressed state, the latter may be made to sparkle like Champaign. And if the vessels are strong, there will be no danger of their bursting in the operation.

If the vessels be suffered to stand six or eight hours, the water will be sufficiently impregnated even without agitation. But by employing the means above described, it may be done in as many minutes.

The water thus impregnated may be drawn out at the opening *k*. But if it is not wanted immediately, it will be better to let it remain in the machine, where it has no communication with the external air. Otherwise the fixed air flies off by degrees, and the water becomes vapid and flat; as also happens to other acidulous waters. But it may be kept a long time in bottles well stoppered, especially if they are placed with their mouths downwards.

Mr. Blades of Ludgate-Hill has still farther improved this apparatus, by changing the stopple at *k* for a glass cock, which is more convenient. He has likewise altered the middle vessel B into a form more advantageous for the impregnation. See *fig. 5.*

For Dr. Hulme's method of impregnating water with fixed air, we refer to his "Safe and easy Remedy for the Stone," &c. 1778: observing, that he merely mixes the solution of fixed alkaline salt and water, containing as much vitriolic acid as he finds necessary, *à priori*, for neutralizing the alkali, and expelling from it all its fixed air.

Dr. Withering, of Birmingham, has lately contrived a new apparatus for impregnating water with fixed air, which, he says, is preferable to that in common use, because it can be made at less expence, and is more easily prepared; because the whole quantity of fixable air produced is converted to use, without any waste of the vitriolic acid; because it impregnates three times the quantity of water at one time, more completely and with less trouble; and the impregnated water will always retain its virtue, if the joints and cocks of the machine are made perfectly air-tight; for which purpose they should once a year be supplied with a small quantity of unsalted lard. This apparatus is exhibited in *fig. 6*, and consists of a glass vessel A, about ten inches high in the cylindrical part, and six inches and a half in diameter; another glass vessel B, about twelve inches high in the conical part, one inch and a half in the neck, and five inches in diameter at the bottom; a copper pipe C passing through the stopper of the vessel B, and tied fast in the flexible tube D, made of strong leather, air-tight,

and kept hollow by means of a spiral wire passing through its whole length; a conical brass pipe E, with a stop-cock fallen to the tube D; another conical pipe F, with a stop-cock G, into which the end of the tube E is accurately ground, so as to be air-tight, and cutting off all communication with the atmosphere when the pipe E is removed; two large hog's bladders H, H, each of which ought to hold two quarts; a stop-cock I, to prevent the water rising into the bladders, when the vessel A is agitated; a bladder K, tied to the crooked tube with the stop-cock L, which occasionally opens or shuts the communication with the vessel B; a glass funnel M, accurately fitted with the glass stopper N; an aperture O, fitted with a glass stopper or a silver cock, from which the impregnated water is to be drawn for use; and, lastly, the tube P opening into the vessel A. When this apparatus is used, let the vessel A be filled with pure water, and any other ingredients that are required, in a proper proportion; into the vessel B put as much marble or whiting, in small lumps, as will cover its bottom to the height of about two inches, and pour in water to the height represented by the dotted line; let the mouth of the vessel A be well fitted with a cork, and through a hole in the cork pass the tube P, putting upon the cork melted sealing-wax of the softest kind, or modelling-wax, so as to make the whole air-tight. The modelling-wax may be procured at the engravers, or it may be prepared by adding to half a pound of melted bees-wax, two ounces of tallow, and one ounce of Venice turpentine: to this mass add a sufficient quantity of red lead, or Spanish brown, to give it a colour, and let the mixture be stirred till it is cold: let the mouth of the vessel B be stoppered with a piece of mahogany, turned into a conical figure in a lathe, and of a size somewhat larger than the mouth of the glass will admit; put this piece of wood into melted bees-wax, and heat the wax till the wood begins to grow black: when cool, turn it again till it fits the mouth of the vessel: the tubes C, L, and M, are fitted into holes bored through the wooden stopper, previous to its being immersed in the wax: push these tubes through the holes, and press the stopper into the orifice of the vessel B, and cement the whole with sealing or modelling-wax: shut the stop-cocks I and L, having previously pressed the air out of the bladder K; open the stop-cocks G and E; then squeeze the air out of the bladders H, H, and afterwards press the conical pipe E into the pipe F: pour about a large spoonful of oil of vitriol through the funnel M, and stop it with its stopper N. The fixable air let loose by the effervescence in the vessel B, rising through the tube C, passes into the bladders H, H, and distends them. In this case open the stop-cock I, and from the aperture O draw out about a quart of water; and the space before occupied by the water will be filled with fixable air, which soon begins to be absorbed by the remaining water, and is still supplied from the bladders H, H, and from the effervescing mixture in the vessel B. When the bladders are considerably collapsed, more vitriolic acid must be added through the funnel M, so that they may be always kept pretty fully distended. When an impregnation is speedily required, turn the stop-cocks at G and E, and open that at L; then separate the pipe E from the tube F, and agitate the vessel A; the fixable air will pass into the bladder K, and may be pressed into the two other bladders, when the parts of the apparatus are united. During the agitation, the stop-cock at I should be closed, and open only occasionally to supply out of the bladders H, H, the fixable air absorbed by the water. If a strong impregnation be required, this process should be carried on in a room, the heat of which does not exceed forty-eight degrees of Fahrenheit's thermometer. Dr. Withering observes,

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observes, that the impregnated water receives no taste from the bladders: and that if the vessel A with its impregnated water be separated from the vessel B, at the conical parting E F, it may be inclosed in a pyramidal mahogany case, out of the lower part of which the silver cock at O projects; and thus serve for an ornamental as well as a luxurious and salubrious addition to the side-board, particularly in the summer and autumnal seasons.

Mr. Henry has described a method of impregnating water in large quantities with fixed air, so as to give it the properties of mineral water, for the use of the sick on board of ships, and in hospitals. He has given the following account of his apparatus and process for this purpose. Cut off the two extremities of a calf's or pig's bladder *f*, (*fig. 7.*) and having previously moistened them, into one end insert the top of the tubular stopper *e*, round the neck of which it is to be closely fastened with strong thread. Into the upper end introduce the part *g* of the long bent tube *h*, and tie them round in the same manner. The pipe *h* must be passed through a hole formed by a hot iron borer, in a large cork adapted to the orifice *i* in the cask B B, holding about ten or twelve gallons, to which it must be cemented: and the length of the pipe from this point must be such as to reach within a few inches of the bottom of the cask B B, which is to be completely filled with fresh water, or such as has been recovered from lime. See PUTREFACTION of Water.

To a quantity of mild calcareous earth and water, placed in the air-vessel C, add a small portion of strong vitriolic acid, and by the time most of the common air may be supposed to be expelled by the fixed air arising from the mild calcareous earth, add a larger quantity of acid, and putting the tubulated stopper *e* in its place, the bladder *f* will become inflated. Press it gently till its sides collapse; and then introducing the pipe *h h*, with its cork, into the orifice *i* of the cask B B, again press the air forward, as it distends the bladder into the water cask, where, bubbling up through the water, it will rise to the surface, and by its pressure, force the water to ascend into the funnel *k*, which is to be cemented into the head of the cask at *l*. In proportion as the water in the cask becomes impregnated with fixed air, that in the funnel will return into its place; but if, at any time, the latter should rise so high as to be in danger of overflowing, a quantity of air may be let out of the water cask, by means of the small plug at *m*. And this is necessary to be done, occasionally, to discharge the residuum of the fixed air, which is not soluble in water.

If the operation be required to be performed more expeditiously, it may be quickened by agitating the water cask. To do this, the tubular stopper *e* must be withdrawn from the air-vessel, and supported, together with the bladder, by an assistant, while the cask B B is shaken. During this time another tubular stopper must be put into the air-vessel, and it may be immersed into a quantity of lime-water to prevent waste. When the agitation has been continued for some minutes, in proportion to the falling of the water in the funnel, replace the stopper attached to the bladder *f* in the air-vessel when taken out of the lime-water, and proceed as before, repeating the agitation occasionally.

During the process, additional quantities of vitriolic acid may be introduced into the air-vessel through the opening at *d*, which is to be, at all other times, carefully secured with its stopper.

By this process, fixed air may be imparted to wine, beer, and almost any liquor whatever. And when beer is become flat or dead, it will be revived by this means; but the delicate agreeable flavour, or acidulous taste communicated by

the fixed air, and which is manifest in water, will hardly be perceived in wine, or other liquors, which have much taste of their own.

The artificial mineral waters thus made, are more pleasant to the taste than the natural Pyrmont or Seltzer waters; which, besides their fixed air, contain saline particles of a disagreeable taste, which are known to contribute little or nothing to their medicinal virtues, and may, in some cases, be hurtful. They are likewise considerably stronger. According to sir John Pringle, these waters may be made more nearly to resemble genuine Pyrmont water, by adding to each pint of them from eight to ten drops of tinctura martis cum spiritu salis. Or this may be done, by adding to the water in the middle vessel B (*fig. 2.*) in the proportion of about thirty grains of Epsom salt, ten grains of common salt, a scruple of magnesia alba, and a drachm of iron filings, or iron wire, clean and free from rust, to one gallon of spring water, and impregnating the whole with fixed air in the manner already described. Let them remain till the other ingredients, and as much of the iron as is necessary, are dissolved, which will be in two or three days; or the magnesia may be omitted, and then the operation will be finished in less than half that time. These waters may be rendered ferruginous or chalybeate very easily, by putting in the middle vessel two or more slender phials, filled with cuttings of fine iron-binding wire, or with small iron nails; because the impregnated water will dissolve the iron so fast, as to become well saturated with it in a few hours, according to the experiments of Mr. Lane. But the method of rendering these artificial waters chalybeate, used by Dr. Hulme, is to add one grain of salt of steel to each pint (sixteen ounces) of water already impregnated with fixed air.

The discovery of an easy method of impregnating water with fixed air is of great importance; as it is now well known that such water is a very powerful antiseptic, or that it both resists and corrects putrefaction. It is, therefore, given with great success in putrid fevers, in the febricula, in dysenteries, in mortifications, and in other disorders arising from a putrid cause, or attended with putrefaction, a draught of it being taken now and then, or even by way of common drink. But the ingenious Mr. Bewly has invented a still better method of exhibiting fixed air as a medicine. He directs a scruple of alkaline salt to be dissolved in a sufficient quantity (a quarter of a pint, or less) of water, which is to be impregnated with as much fixed air as it can imbibe; this is to be drank for one dose. Mr. Bewly directs it to be prepared in larger quantities at a time, and calls it his mephitic julep. If immediately after it a spoonful of lemon juice, mixed with two or three spoonfuls of water, and sweetened with sugar, be drank, the fixed air will be extricated in the stomach; and thus a much greater quantity of it may be given than the same quantity of water alone can be made to imbibe. Fixed air acts as a corroborant; and, therefore, may be given with success in weakness of the stomach, and in vomitings arising from that cause. It has also been given with success in the stone, and in nephritic complaints. When the lungs are purulent, fixed air, mixed with the air drawn into the lungs, has repeatedly been found to perform a cure. The bark also may be given with advantage in water impregnated with fixed air, as they both coincide in the same intention. Fixed air may be applied by means of a syringe, funnel, or otherwise, to inflamed breasts, putrid ulcers, mortified parts, ulcerated sore throats, and has been found in such and similar cases to have very remarkable efficacy. It may also be given internally at the same time. In putrid dysenteries, and in putrid stools, fixed air may be given by way of clyster.

Ferment-

Fermenting cataplasms are of service chiefly as they supply fixed air to the part. In cases of putridity, fixed air has been successfully applied to the surface of the body, exposed to streams of it. It is also found an excellent cooling as well as strengthening beverage in hot relaxing weather, and has the advantage of being pleasant to the taste. See on the subject of this article Priestley's Exp. and Obs. on Air, vol. ii. p. 263, &c. 298, &c. Phil. Trans. vol. lxx. part i. p. 59, &c. Magellan's Description of a Glass Apparatus for making Mineral Waters, &c. p. 1, &c. Priestley's Exp. and Obs. vol. v. Appendix, p. 389, &c. Elliot's Account of the Nature and medicinal Virtues of the principal Mineral Waters, &c. 1781. Henry's Account of a Method of preserving Water at Sea, &c. 1781. p. 19, &c.

PYROBOLUS, or the art of missile fires, is derived from the Greek πυρ, *fire*, and βολαιον, *to throw*. See PYROTECHNY.

PYROBOLUS, in *Natural History*, a name given by many authors to the stone more generally called *pyrites*; others have called it *siderites*, *pyrobalanus*, *pyropus*, and *olbonna*, and the Greeks *mylias*.

PYROCHROA, in *Entomology*. See LAMPYRIS.

PYROCTOGONIUM, in *Natural History*, the name given by Dr. Hill to a genus of fossils usually comprehended by authors, with many other bodies of a different figure and structure, under the general name *pyrites*.

The characters of the pyroctogonium are these: it is a compound, inflammable, metallic body, of a regular octohedral figure, or composed of eight planes.

There is only one known species of this genus, which is a very singular and elegant fossil, being composed of eight triangular planes; these being the sides of two quadrilateral pyramids, with broad bases, which being joined base to base, constitute the pyroctogonium.

It is found very frequently in Cornwall, Devonshire, and most other of our counties where there are mines. It is sometimes met with loose in the earth, sometimes lodged in the bodies of marcasites, or in the solid fossils, and varies sometimes from its iron colour to a dusky yellow. It is sometimes also found with many specimens connected into a mass; these are seldom uniform in size, and cohere in various directions, often greatly injuring one another's figure. Sometimes also, as in the case of the crystals, they form a large mass, of which the outer surface only is concreted into or covered with regular figures, the whole inner part being a confused substance.

Masses of this kind are not unfrequently found of a regular orbicular figure, and beset all over with regularly figured pyroctogonia of various sizes. Hill.

PYRODMALITE, in *Mineralogy*, a mineral discovered some years ago in the mine of Bjelke, in Vermeland, a province of Sweden, situated on the N. side of the lake Venner, which was observed to have the property of giving out the odour of muriatic acid when heated, and hence distinguished by the name of pyrodmalite. J. G. Gahn of Fahlun has given the following description of it. Its colour is commonly yellowish-brown, passing into greenish: internally, it is light greenish-yellow. It occurs crystallized in regular six-sided prisms, without any terminating pyramids. It is composed of plates lying on each other in a direction perpendicular to the axis of the prism; principal fracture, resplendent; cross fracture, uneven and without lustre; opaque; semi-hard; scratched by steel; the crystals are often several inches long; specific gravity 3.081. Before the blowpipe it becomes dark reddish-brown, and emits the odour of muriatic acid. It then melts into a black slag, and at last a small bead is obtained, more or less attracted

by the magnet. It dissolves readily, and in considerable quantity in glass of borax, and gives a colour indicating the presence of manganese and iron:—in phosphate of ammonia and soda it dissolves with great difficulty. Its constituents are silica, lime, iron, manganese, and muriatic acid. In the mine of Bjelke it occurs mixed with iron ore, calcareous spar, and black crystallized malacolite. Pyrodmalite was lately analysed by Mr. Hisinger, who found its constituents to be as follow:

Silica	-	-	-	35.4
Oxyd of iron	-	-	-	32.6
Oxyd of manganese	-	-	-	23.1
Alumina	-	-	-	0.6
Muriatic acid	-	-	-	6.5
Loss	-	-	-	1.8

100.0

The escape of the acid by heat seems to indicate the presence of a portion of water amounting to about two-thirds of the loss stated as sustained in the analysis. Annals of Philosophy, N^o 12.

PYROENUS, formed of πυρ, *fire*, and οινος, *wine*, is a term sometimes used for rectified spirit of wine; thus called because made by fire, or rather because rendered of a fiery nature.

PYROET, **PYROUT**, or rather *Pirouette*, in the *Manège*. See **PIROUETTE**.

PYROLA, in *Botany*, a name adopted by Linnæus from the old authors, but not one of their best. It is a diminutive of *Pyrus*, and alludes to the resemblance of the leaves, in this pretty genus, to those of a pear-tree.—Linn. Gen. 221. Schreb. 297. Willd. Sp. Pl. v. 2. 621. Mart. Mill. Dict. v. 3. Ait. Hort. Kew. v. 3. 58. Pursh 299. Sm. Fl. Brit. 443. Prodr. Fl. Græc. Sibth. v. 1. 274. Juss. 161. Tourn. t. 132. Lamarck Illustr. t. 367. Gært. t. 63. (*Chimaphila*; Pursh 300.)—Class and order, *Decandria Monogynia*. Nat. Ord. *Bicornes*, Linn. *Erica*, Juss.

Gen. Ch. Cal. Perianth inferior, small, in five deep segments, permanent. Cor. Petals five, roundish, concave, spreading. Stam. Filaments ten, awl-shaped, shorter than the corolla; anthers drooping, large, with two horns at the base, each discharging the pollen by a terminal orifice. Pist. Germen superior, roundish, angular; style cylindrical, permanent, various in length and direction, sometimes scarcely any; stigma thickish, variously shaped. Peric. Capsule roundish, depressed, five-sided, of five cells, bursting at the angles. Seeds numerous, chaffy.

Eff. Ch. Calyx in five deep segments. Petals five. Capsule superior, with five cells, bursting at the angles, and many seeds. Anthers with two pores.

Obs. In some species the stamens and style are erect; in others inclined to one side or the other; in some the former spread every way. The form of the stigma is different in different species. In two American ones the stigma is nearly, or quite, sessile; on which mark Mr. Pursh's genus *Chimaphila* is founded, its name being nearly synonymous with Winter-green, the English appellation of *Pyrola*.

Section 1. *Style elongated*. *Pyrola* of Pursh.

1. *P. rotundifolia*. Round-leaved Winter-green. Linn. Sp. Pl. 567. Willd. n. 1. Ait. n. 1. Pursh n. 1. Engl. Bot. 213. (*Pyrola*; Ger. Em. 408. Camer. Epit. 723. Rivin. Pentap. Irr. t. 136. f. 2. *P. vulgarior*; Clus. Hist. v. 2. 116. Limonium; Fuchs. Hist. 467. L. sylvestre; Trag. Hist. 707.)—Stamens ascending. Style twice as long, deflexed and recurved. Cluster many-flowered. Calyx as long as the stamens.—Native of thickets, for the most

part in mountainous situations, in the more northern parts of Europe, also in North America, flowering in July. We have gathered it on the plain of mount Cenis, and in moist parts of the sandy downs of Holland; opposite to which, on the Norfolk coast, this plant has likewise been found by the accurate Mr. Lily Wigg, growing among bushes, on Bradwell common, not far from Yarmouth; where we likewise have seen it. There is more difficulty in ascertaining an indubitable station of this species in the northern or mountainous parts of Britain, because of the *media* having been so much confounded with it, nor have we any specimens from those countries. The roots are perennial, long, creeping, thread-shaped, scaly. Stems very short and simple, leafy, solitary at the end of each shoot of the root. Leaves four or five; on bordered smooth footstalks of various lengths (from one to two inches); roundish or elliptical, obtuse, an inch or inch and a half long, very obscurely crenate, smooth, shining, reticulated with numerous veins; paler beneath. Flower-stalk terminal, solitary, about a span long, angular, slightly twisted, smooth, bearing a few scattered lanceolate membranous bractees, and terminating in a long, rather loose, cluster, of from four to eight or ten large, handsome, white, drooping, but not quite pendulous, fragrant flowers, each having a similar bractee to the rest, at the base of the partial stalk, and fully equal to it in length. Segments of the calyx lanceolate, acute, full half the length of the petals, which, though usually rounded and blunt, have sometimes a pointed appearance. Stamens about the length of the calyx, all turned upward, and crowded together; their anthers deflexed, yellow, with orange horns. Germen short, five-lobed. Style twice as long as the stamens, slender and quite pendulous in its lower part, gradually swelling towards the extremity, which is recurved. Stigma dilated, annular, with five small central points. Capsule the size of a pea, depressed, five-lobed, crowned with the permanent style and stigma.

2. *P. chlorantha*. Greenish-flowered Winter-green.—Swartz in Stockh. Transf. for 1810. 190. t. 5. (P. folio obtuso, flore viridifusco; Rivin. Pentap. Irr. t. 138. f. 1.)—Stamens slightly ascending. Style twice as long, club-shaped, deflexed and recurved. Cluster many-flowered. Calyx shorter than the stamens.—Native of Sweden, and probably, by the synonym of Rivinus, of Germany, flowering about the middle of July. Professor Swartz distinguishes it from the foregoing, by the smaller, often abrupt, leaves; stalk almost destitute of bractees below; petals of a whitish, or yellowish, green hue; and stamens less curved upwards. We gather also, from his figure and description, that the bractees which accompany each flower are much shorter than the partial stalks, and that the calyx also is shorter, and more close-pressed, than in *P. rotundifolia*. In the posture and form of the style we find no difference. The common flower-stalk is remarkably spiral. Possibly the *P. folio rotundo* of Rivinus, t. 137, may represent this species in fruit; as the posture of the permanent styles agrees better with it than with the following.

3. *P. media*. Intermediate Winter-green. Swartz in Stockh. Transf. for 1804 (not 1784), 257. t. 7. f. 1. Engl. Bot. t. 1945. Winch Guide, v. 2. 19. (P. rotundifolia; Fl. Dan. t. 110.)—Stamens regularly inflexed. Style twice as long, deflexed perpendicularly. Cluster of many pendulous flowers. Calyx shorter than the stamens.—Native of bushy shady places in Sweden, and various parts of the north of England, flowering towards the end of June. We suspect also that this is the Oxfordshire species, commonly mistaken for *minor*, and that it has often in Scotland, from whence we have specimens, been taken for *rotundifolia*. The leaves most agree with the last-named, but the flowers

differ essentially in being smaller, more pendulous, and of a less pure white. The stamens are nearly twice the length of the calyx, all regularly and equally inflexed, not at all turned upward. Style bent in a curve downward, its extremity furrowed, slightly thickened, vertical, not recurved. The stalk is spiral, as in the last, with about two distant bractees in its lower part, the bractees which accompany each flower being nearly as long as the partial stalks. Even Linnaeus may perhaps have confounded this with his true *minor*.

4. *P. minor*. Lesser Winter-green. Linn. Sp. Pl. 567. Willd. n. 2. Ait. n. 2. Engl. Bot. t. 158. Fl. Dan. t. 55. Rivin. Pentap. Irr. t. 136. f. 1. (P. rosea; Engl. Bot. t. 2543.)—Stamens regularly inflexed. Style the same length, straight, stigma lobed, pointless. Cluster of many drooping flowers. Stalk straight.—Native of woods and thickets on the mountains of Europe; occurring in several parts of Scotland and the county of Durham, and flowering in July. This is smaller in general than any of the foregoing; the leaves more elliptical; stalk straight, not spiral, with three principal angles and a smaller one, bearing a few broad bractees near the base, but scarcely any other, except the small awl-shaped ones at each partial stalk. The flowers are very numerous, but small, drooping or even pendulous, white with more or less of a pink tinge. Stamens regularly incurved. Pores of the anthers dilated, not tubular. Style straight, of a much shorter proportion than any of those we have hitherto mentioned; the stigma large, five-lobed; depressed, and destitute of points, in the centre. We can no longer doubt that t. 158 and t. 2543 of English Botany represent one and the same species, which we possess also from mount Cenis, Savoy, and Switzerland, as well as in the Linnæan herbarium. *P. media*, having been confounded by botanists in general with this, has caused all our perplexity expressed in Engl. Bot. 2543. The plant which Mr. Lightfoot introduced at Bullstode, we judge from memory to have been *media*; see Engl. Bot. 158.

5. *P. asarifolia*. Asarabacca-leaved Winter-green. Michaux Boreal-Amer. v. 1. 251. Pursh n. 2.—“Leaves kidney-shaped. Stalk with a few sheathing, convoluted, distant scales. Flowers turned every way. Style declining.” Michaux.—Found by Michaux in Canada; by Pursh in beech woods on the mountains of Pennsylvania, flowering in July. The flowers are yellowish-green. If it were not for the “sheathing scales,” we should suspect this might be the same as our *chlorantha*, n. 2, whose leaves are often, it seems, short and abrupt; but we have seen no specimens answerable to either.

6. *P. dentata*. Toothed Winter-green.—Leaves elliptic-obovate, obtuse, toothed. Stalk straight, obscurely angular, nearly naked. Stamens ascending. Style deflexed, strongly recurved. Stigma with a cylindrical point. Gathered by Mr. Menzies, on the west coast of North America. This species is readily distinguished from all others, hitherto discovered, by its leaves, which are obovate, or somewhat elliptical, one and a half or two inches long, half or three quarters of an inch broad; their margin beset with very remarkable distinct, small, blunt teeth, usually near a quarter of an inch asunder; their surface not reticulated, but furnished with one series of connected arching veins, on each side the midrib. Footstalks triangular, about as long as the leaves. Flower-stalk six inches long, nearly naked, round, very slightly angular, bearing a long loose cluster of flowers, much resembling those of the first species in size and structure, as well as in the position of their stamens; but their style is still more remarkably recurved, so as to form a semicircle; and the point of the stigma much more prominent, of a cylindrical shape, five-cleft at the summit.

7. *P. apylla*. Leafless Winter-green.—Stem and stalk scaly,

scaly, without leaves. Anthers beaked. Style deflexed and recurved. Stigma with a cylindrical point.—Gathered on the west coast of North America, by Mr. Menzies, who assures us the plant is always quite destitute of *leaves*, instead of which the angular *stem* bears numerous lanceolate, membranous, pointed *scales*, about half an inch in length, a few similar but more remote ones being scattered along the *stalk*, which is angular. The *flowers* are nearly as large as the last, but our dried specimen will not allow us to determine the posture of the *filaments*. The *anthers* are long and narrow, with a small acute point at the contrary end to the pores. Style deflexed, its end somewhat recurved. Stigma with a long cylindrical point, like the last.

8. *P. picta*. Variegated Winter-green.—Leaves ovate, somewhat ferrated. Flowers drooping all one way. Pores of the anthers contracted, tubular. Style curved. Stigma abrupt, with five small points.—This also was found by Mr. Menzies on the west coast of North America. In some points it agrees with the two last, as well as with the *rotundifolia* and its allies; in others it resembles the following, but is a totally distinct species. The *leaves* are near an inch and half long, and almost an inch wide, ovate, bluntish, with shallow, more or less distant, ferratures, rather fleshy, marked with large branching veins, and variegated with white or yellowish blotches. *Footstalks* nearly as long as the leaves. *Flower-stalk* six inches long, obliquely ascending, quadrangular, twisted, bearing two or three short, ovate, pointed scales. *Flowers* numerous, as big as those of the *rotundifolia*, all, as far as we can judge from the dried specimen, drooping toward one side. *Calyx* short, broad, and spreading. *Stamens* all, as far as can be discerned, alike disposed round the germen; their *anthers* short, ovate, minutely pointed, the pores prominent in the form of two short narrow tubes, contracted at the orifice. Style curved, but we cannot tell in what direction. Stigma scarcely at all thicker than the style, abrupt, with an acute edge, and apparently five minute sharp central points.

9. *P. secunda*. Serrated Winter-green. Linn. Sp. Pl. 567. Willd. n. 3. Ait. n. 3. Pursh n. 4. Fl. Dan. t. 402. Engl. Bot. t. 517. (*P. secunda* tenerior; Clus. Hist. v. 2. 117. Ger. Em. 408. *P. folio mucronato*; Rivin. Pentap. Irr. t. 138. f. 2.)—Leaves ovate, acute, ferrated. Flowers drooping all one way. Pores of the anthers dilated. Style straight. Stigma dilated, five-lobed.—Native of mostly alpine woods in various parts of Europe, from Lapland to Greece, as well as of sandy barren woods in North America, from Canada to New Jersey, flowering in July. It occurs in fir or birch woods, in several parts of the highlands of Scotland; as also near Moffat in the lowlands; and according to Ray in Yorkshire. The *stems* are long and trailing. *Leaves* scattered or crowded, an inch or more in length, with numerous fine shallow ferratures, and abundance of reticulated veins. *Footstalks* half the length of the leaves. *Flower-stalk* from three to six inches long, erect, straight; round below; angular above; with two or three green ovate scales. *Cluster* of many crowded greenish-white *flowers*, not half the size of the foregoing, nor so much expanded. *Stamens* regularly placed round the germen, at first curved, then straight. *Anthers* whitish, short, pointless; their pores somewhat oblique, but not tubular, soon becoming dilated and jagged. Style straight, twice the length of the flower. Stigma much dilated, annular, but thin-edged, terminating in a large five-lobed umbilicated summit.

10. *P. uniflora*. Single-flowered Winter-green. Linn. Sp. Pl. 568. Willd. n. 6. Ait. n. 6. Pursh n. 5. Fl. Dan. t. 8. Engl. Bot. t. 146. (*P. quarta minima*; Clus. Hist. v. 2. 118. Ger. Em. 408. *P. flore singulari*; Rivin.

Pentap. Irr. t. 139. f. 1.)—Stalk bearing a solitary flower. Pores of the anthers contracted, tubular. Stigma with five rays.—Native of alpine forests, among mossy hills, in various parts of Europe and North America. It was first discovered, in the British dominions, by Mr. James Hoggan, who gathered wild specimens, now before us, in the western islands of Harris and Bernera, in 1783. Mr. James Hoggan, and Mr. Brodie of Brodie, have also gathered this most elegant and curious plant in fir woods of the county of Moray. It is, like the rest, perennial and evergreen, blossoming in July. The *leaves* vary greatly in shape and acuteness, but are generally roundish, about an inch long, more or less strongly ferrated, and reticulated with many veins. *Footstalks* half as long. *Flower-stalk* solitary, simple, erect, three inches high, with one concave *bractea*, and a large, terminal, white, or slightly reddish, *flower*, an inch in diameter, and smelling like lily of the valley. *Stamens* spreading equally, half the length of the corolla, three of them lying on one of the petals, one only on another, and two on each of the three remaining. *Anthers* short, ovate, pointless; their pores tubular, considerably elongated. Style erect, straight, the length of the germen. Stigma large, of five thick, spreading, acute, ray-like lobes. The wild specimen delineated in English Botany, having travelled from so great a distance, was in too imperfect a condition to allow of that figure being so good as usual.

Section 2. *Stigma nearly sessile*. *Chimaphila* of Pursh.

11. *P. umbellata*. Umbellated Winter-green. Linn. Sp. Pl. 567. Willd. n. 4. Ait. n. 4. Curt. Mag. t. 778. (*P. tertia fruticans*; Clus. Hist. v. 2. 117. Ger. Em. 408. *P. folio arbuti*; Rivin. Pentap. Irr. t. 139. f. 2. *Chimaphila corymbosa*; Pursh n. 2.)—Leaves obovate, ferrated. Flowers somewhat umbellate. Stigma nearly sessile. *Stamens* smooth.—Native of woods in the northern parts of Europe, Asia and America, but not found wild in Britain. Mr. Menzies gathered it on the west coast of North America, and Mr. Pursh found it frequent in dry woods, from Canada to Virginia. Linnæus, Gmelin, Pollich, Roth, &c. give it in their Floras. Dr. Sims, who received this species in flower in June, from Mr. Loddiges, justly asserts it to be the most beautiful of all the genus. The *stem* is woody, a span high, somewhat branched, angular, and roughish. *Leaves* crowded together into something like whorls, stalked, narrow-obovate, bluntish, strongly ferrated; dark green and veiny above; paler beneath; about an inch and a half long. *Flower-stalks* terminal, solitary, three inches long, reddish, bearing about five, imperfectly umbellate, simple, partial stalks, each an inch long, spreading, rough with glandular pubescence, and sometimes furnished with a little lanceolate *bractea*. *Flowers* smaller than that of *P. uniflora*, but larger than any other of the foregoing, drooping. *Petals* orbicular, concave, cream-coloured; crimson at the base. *Stamens* short, red, all regularly inflexed. *Anthers* short, purple, with white tubular pores, dilated and lobed at the orifice. *Germen* globose, green. Style thick and very short, but certainly present. Stigma orbicular, convex, with five slight notches. The American specimens are usually less umbellate, and more racemose, than the European.

12. *P. maculata*. Holly-leaved Winter-green. Linn. Sp. Pl. 567. Willd. n. 5. Ait. n. 5. Curt. Mag. t. 897. (*P. mariana*, *arbuti foliis angustioribus*, &c.; Pluk. Mant. 157. Phyt. t. 349. f. 4. *Chimaphila maculata*; Pursh n. 1.)—Leaves ovato-lanceolate, with tooth-like ferratures. Stalks two or three-flowered. Stigma nearly sessile. *Stamens* woolly.—This is exclusively an American species. Mr. Pursh observed it in shady gravelly or sandy woods, from Canada to Carolina, and Mr. Menzies brought speci-

mens from the north-west coast. It is now and then met with in our more curious gardens, requiring bog earth, with shade and moisture, and flowering in June and July. Its shrubby habit is like the last, but of more humble growth. *Leaves* more pointed, with sharper tooth-like serratures; their upper surface marked, along the rib and veins, with a pale stripe. *Partial flower-stalks* usually two, rarely three, drooping. *Flowers* the size of the last, but white. *Stamens* densely fringed in their lower part. *Antlers* with tubular jagged-mouthed pores. *Style* very short and thick. *Stigma* hemispherical, nearly entire, green. Mr. Pursh says this plant is in high esteem among the natives of North America for its medicinal qualities, and is called *Sip-sjerwa*. He witnessed a successful cure of severe hysterics by a decoction of this *Pyrola*.—We can by no means assent to the establishment of that able writer's genus *Chimaphila*, hinted at by Michaux; there being surely no diversity of habit to support it; nor any character, but a difference of length in the style; which the other species of *Pyrola* shew to afford admirable specific, but no generic, distinctions.

PYROLAMPIS, in *Zoology*. See **GLOW-worm**, and **LAMPYRIS**.

PYROLIGNEOUS ACID, or *Empyreumatic acid of wood*, in *Chemistry*, a species of empyreumatic **ACETOUS ACID** (which see), procured by distilling in a glass or earthen retort a quantity of shavings of any kind of wood, such as box, guaiacum wood, or beech; in which case an extremely strong-smelling dark-coloured empyreumatic acid liquor is obtained, nearly one-third of the weight of the wood. This acid is sourer, and also much blacker and more empyreumatic, than either the *pyromucous* or *pyrotartareous* acid, probably as requiring a stronger heat for its production. The acid of wood is obtained in a large quantity near London, from the preparation of charcoal for gunpowder, by distilling wood in cast-iron cylinders. It stains the hands deeply, and wood indelibly. This acid is procured in such a quantity as to be an object of manufacture. At the best it is only an inferior acetous acid, and the difficulty of purifying it will prevent the profitable use of it in many of the arts to which vinegar is applied. However, as the process for procuring radical vinegar at the same time purifies this empyreumatic acid, it may probably be used for this purpose. It may be added, that much of the acid from the distilled charcoal for gunpowder, near London, is employed by calico-printers in forming the acetated iron, used as a mordant, as in this case the colour and smell of the acid are not at all detrimental. Some time ago Vauquelin announced, as a *new* discovery, that pyroligneous acid is identically the same as the acetous; but this was known to Glauber near 200 years ago. In the folio edition of his works, p. 188, may be seen directions for its distillation, with a copper-plate of the

apparatus which he employed. He there calls it the vinegar of wood. Parker's Chem. Catech. p. 195, note.

PYROMACHUS, a name given by some to antimony, when reduced to a stony hardness; and by others to copper, when fused with sulphur, and thus rendered less ductile.

PYROMANCY, *πυρομαντεία*, a kind of divination, performed by means of fire.

The ancients imagined they could foretell futurity by inspecting fire and flame: to this end they considered its direction, or which way it turned. Sometimes they added other matter to the fire, *e. gr.* a vessel full of urine, with its neck bound about with wool, watching narrowly on which side it would burst, and thence taking their augury.

Sometimes they threw pitch on it, and if it took fire immediately, they esteemed it a good augury.

PYROMETER, formed of *πυρ*, *fire*, and *μετρον*, *I measure*, in *Physics*, the name of a machine contrived to measure the alteration of the dimensions of metals, and other solid bodies, arising from heat.

These instruments have been constructed of various forms; but as their object is to render the small expansions of solids apparent to the observer, they have consisted of a machine adapted to this purpose, and of an apparatus fit for heating the bodies under examination to a determined degree.

The most usual, and, indeed, the most eligible mode of heating the bodies, is to place them in water, in which a thermometer is placed, and to heat the water by means of lamps. The small expansions of the heated solids have been rendered visible, *first*, by multiplying-wheels, or by levers, or by fine screws, which render a small motion communicated to one end of the mechanism productive of a great movement at the other end; and, *secondly*, by magnifying the small expansion through microscopes; which seems, upon the whole, to be the method that is both most certain and most manageable; for with wheels and pinions, and even with levers or screws, there is always some equivocal motion, arising from the loose connection of teeth and pinions, or from the stress and bending of other parts.

Muschenbroek, who was the original inventor of this machine, has given a table of the expansion of the different metals, in the same degree of heat. Having prepared cylindrical rods of iron, steel, copper, brass, tin, and lead, he exposed them first to a pyrometer with one flame in the middle; then with two flames; and successively to one with three, four, and five flames. But previous to this trial, he took care to cool them equally, by exposing them some time upon the same stone, when it began to freeze, and Fahrenheit's thermometer was at thirty-two degrees. The effects of which experiment are digested in the following table, where the degrees of expansion are marked in parts equal to the $\frac{1}{125000}$ th part of an inch.

Number of Flames.	Expansion of					
	Iron.	Steel.	Copper.	Brass.	Tin.	Lead.
By one flame - -	80	85	89	110	153	155
By two flames placed close together	117	123	115	220		274
By two flames $2\frac{1}{2}$ inches distant	109	94	92	141	219	263
By three flames placed close together	142	168	193	275		
By four flames placed close together	211	270	270	361		
By five flames - -	230	310	310	377		

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It is to be observed of tin, that it will easily melt when heated by two flames placed together. Lead commonly melts with three flames placed together, especially if they burn long.

From these experiments it appears, at first view, that iron is the least rarefied of any of these metals, whether it be heated by one or more flames; and therefore is most proper for making machines, or instruments, which we would have free from any alterations by heat or cold, as the rods of pendulums for clocks, &c. So likewise the measures of yards or feet should be made of iron, that their length may be as nearly as possible the same, summer and winter.

The expansion of lead and tin, by only one flame, is nearly the same; that is, almost double of the expansion of iron. It is likewise observable, that the flames, placed together, cause a greater rarefaction than when they have a sensible interval between them; iron, in the former case, being expanded 117 degrees, and only 109 in the latter; the reason of which difference is obvious. By comparing the expansion of the same metal, produced by one, two, three, or more flames, it appears, that two flames do not cause double the expansion of one; nor three flames three times that expansion, but always less; and these expansions differ so much the more from the ratio of the number of flames, as there are more flames acting at the same time.

It is also observable, that metals are not expanded equally at the time of their melting, but some more, some less. Thus, tin began to run, when rarefied 219 degrees; whereas brass was expanded 377 degrees, and yet was far from melting.

As to the construction of M. Muschenbroeck's pyrometer, together with Defaguliers's alterations and improvements, the curious may consult Defagul. *Experim. Philos.* vol. i. p. 421, &c. See also Muschenbroeck's translation of the experiments of the Academy del Cimento, printed at Leyden in 1731. And for a pyrometer of a new construction, by which the dilatations of metals in boiling fluids may be examined and compared with Fahrenheit's thermometer, see Muschenb. *Introd. ad Philosophiam Nat.* 4to. 1762, vol. ii. p. 610.

But it has been observed, that M. Muschenbroeck's pyrometer was liable to some objections; and a contrivance was made, with a view of removing these, by Mr. Ellicott, who has given a description of his improved pyrometer in the *Philosophical Transactions*, N° 443. This may also be seen in Dr. Martyn's *Abridgment*, vol. viii. p. 464.

This instrument is formed with a flat piece of brass A A, (*Plate XXIII. Miscellany, fig. 4.*) which is screwed down to a thick piece of mahogany. Upon this plate are screwed three pieces of brass, two of which, B, B, serve to support the flat iron bar C, called the standard bar. The upper part of the third piece of brass is a circle D, about three inches in diameter, divided into three hundred and sixty equal parts, or degrees: within this circle is a moveable plate *d*, divided likewise into three hundred and sixty parts, and a small steel index. The bar of metal E, upon which the experiment is to be made, is laid on the standard bar. F is a lever two inches and a half long, fastened to an axis, which turns in two pieces of brass, screwed to one of the supports B. To the end of this lever is fastened a chain, or silk-line, which, after being wound round a small cylinder, to which the index in the brass circle, D, is fastened, passes over a pulley, with a weight hung to the end of it. Upon the axis, to which the lever is fixed, is a pulley, a quarter of an inch in diameter, to which a piece of watch-chain is fastened, the other end of which is hooked to a strong spring G, which bears against one end of the metal E.

H is a lever, exactly of the same form and dimensions with the other; but the chain fastened to the pulley on its axis is hooked to the standard bar. The line fastened to the end of this lever, after being wound round a cylinder, to which the moveable plate is fixed, passes over a small pulley, and has a weight hung to the end of it; or rather the same line, passing under a pulley to which the weight is hung, has its other end fastened to the lever F; so that one weight serves for both levers. From this description it is plain, that whenever the bar E is lengthened, it gives liberty to the weight to draw the lever F upwards by its action to the spring G; and the index will, at the same time, by means of the silk line, be carried forward in the circle; and as the bar shortens, it will return back again: the same motion will be communicated to the standard bar. When the bar is lengthened the 20th part of an inch, the index will be carried once round the brass circle, which is divided into three hundred and sixty degrees; and, therefore, if the metal lengthens the 7200th part of an inch, the index will move one degree. In order to make an experiment with this instrument, lay a bar of any kind of metal, as E, on the standard bar; then heat this bar to any degree of heat with a lamp, and mark the degree of its expansion, as indicated by the moveable plate; observe also the degree of expansion of the metal E, by the heat communicated to it from the standard bar, as marked on the brass circle by the index: let the instrument stand, till the whole is thoroughly cold; then removing the bar E, lay any others successively in its place, and proceed exactly as before; and thus the degrees of expansion of different metals, by the same degree of heat, may be estimated.

By the help of this instrument Mr. Ellicott found, upon a medium, that the expansion of bars of different metals, as nearly of the same dimensions as possible, by the same degree of heat, were as follow:

Gold,	Silver,	Brass,	Copper,	Iron,	Steel,	Lead,
73	103	95	89	60	56	149

The great difference between the expansions of iron and brass, has been applied with good success to remedy the irregularities in pendulums arising from heat. *Phil. Transf.* vol. xlvii. p. 485. See *PENDULUM*.

Mr. Graham used to measure the minute alterations, in length, of metal bars, by advancing the point of a micrometer-screw, till it sensibly stopped against the end of the bar to be measured. This screw, being small and very lightly hung, was capable of agreement within the three or four thousandth part of an inch. On this general principle Mr. Smeaton contrived his pyrometer, in which the measures are determined by the contact of a piece of metal with the point of a micrometer-screw. A B C D (*fig. 5.*) represents the main bar or basis of this instrument; E F is the bar to be measured, lying in two notches, one fixed to the upright standard A B, the other to the principal lever H I; the end E of the bar E F bears against the point of G, a screw which is of use in examining the micrometer-screw; the other end of the bar F bears against a small spherically protuberant bit of hard metal, fixed at the same height as G, in the principal lever H I; K is an arbor fixed in the basis, which receives at each end the points of the screws, H, L, upon which the lever H I turns and serves as a fulcrum to it; O is a slender spring, to keep the lever in a bearing state against the bar; and P is a check, to prevent the lever from falling forward, when the bar is taken out; N is the feeler, somewhat in the shape of a T, suspended, and moveable up and down upon the points of the screws,

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I, M, which, as well as L, H, are so adjusted as to leave the motion free, but without shake; Q R is the handle of the feeler, moveable upon a loose joint at R, so that laying hold of it at Q, the feeler is moved up and down, without being affected by the irregular pressure of the hand; the extremity, S, of the feeler is also furnished with a bit of protuberant hard metal, to render its contact with the point of the micrometer-screw more perfect; T is the micrometer-screw; V the divided index-plate; and W a knob for the handle; the micrometer-screw passes through two solid screwed holes at D and Y; the piece Y Z is made a little springy, and endeavours to pull the screw backwards from the hole at D, and consequently keeps the micrometer-screw constantly bearing against its threads the same way, and thereby renders the motion thereof perfectly steady and gentle; X is the index, having divisions upon it, answering to the turns of the screw. This piece points out the divisions of the plate, as the face of the plate points out the divisions upon the index. When the instrument is used, lay hold of the knob at Q with one hand, and, moving the feeler up and down, with the other move forward the screw T, till its point comes in contact with the feeler; then will the plate and index, V and X, shew the turns and parts. The basis of this instrument, as well as the other parts of it, is brass: one end of which is continued of the same piece at right angles, to the height of three inches and a half; and the other end acts upon the middle of a lever of the second kind, whose fulcrum is in the basis; and, therefore, the motion of the extremity of the lever is double the difference between the expansion of the bar and the basis. Hence, having the length of the lever from its fulcrum to the point of suspension of the feeler, the distance between the fulcrum and the point of contact with the bar, the inches and parts that correspond to a certain number of threads of the micrometer, and the number of divisions in the circumference of the index-plate; the fraction of an inch expressed by one division of the plate may be deduced. Those measures are as follow: from the fulcrum of the lever to the feeler, 5.875 inches; from the fulcrum to the point of contact, 2.895 inches; length of seventy threads of the screw, 2.455 inches; and the divisions in the circumference of the index-plate, 100. Hence the value of one division will be the $\frac{1}{100}$ th part of an inch: but if the screw be altered one-fourth of one of these divisions, when the contact between the screw and feeler is well adjusted, the difference of contact will be very perceivable to the slightest observer; and, consequently, $\frac{1}{400}$ th part of an inch is perceivable in this instrument. When the instrument is made use of, it is immersed, together with the bar to be measured, in a cistern of water; which water, by means of lamps underneath, is made to receive any intended degree of heat not greater than that of boiling, and thereby communicates the same degree of heat to the instrument, the bar, and to a mercurial thermometer immersed therein, for the purpose of ascertaining that degree. See fig. 6, in which A B is the cistern, C the cover, which, when the instrument (fig. 5.) is raised upon blocks, goes on between the bar E F and the basis B C; D a handle to take off the cover, when hot; E the mercurial thermometer; F the cock, to let out the water; and G H a hollow piece of tin, which supports seven spirit lamps, which are raised higher or lower by the screws I and K, in order to give the water in the cistern a proper degree of heat. With this pyrometer Mr. Smeaton performed several experiments, which are arranged in a table; and their result agrees very well, he observes, with the proportions of expansions of several metals given by Mr. Ellicott. The following table shews how much a foot

in length of each metal grows longer, by an increase of heat corresponding to 180° of Fahrenheit's thermometer, or to the difference between freezing and boiling water, expressed in such parts of which the unit is equal to the 10,000th part of an inch.

1. White-glass barometer-tube	-	-	-	100.
2. Martial regulus of antimony	-	-	-	130.
3. Blistered steel	-	-	-	138.
4. Hard steel	-	-	-	147.
5. Iron	-	-	-	151.
6. Bismuth	-	-	-	167.
7. Copper hammered	-	-	-	204.
8. Copper eight parts, mixed with tin one	-	-	-	218.
9. Cast brass	-	-	-	225.
10. Brass sixteen parts, with tin one	-	-	-	229.
11. Brass wire	-	-	-	232.
12. Speculum metal	-	-	-	232.
13. Spelter folder, viz. brass two parts, zinc one	-	-	-	247.
14. Fine pewter	-	-	-	274.
15. Grain tin	-	-	-	298.
16. Soft folder, viz. lead two, tin one	-	-	-	301.
17. Zinc eight parts, with tin one, a little hammered	-	-	-	323.
18. Lead	-	-	-	344.
19. Zinc or spelter	-	-	-	353.
20. Zinc hammered half an inch per foot	-	-	-	373.

For a farther account of this instrument, with its use, see Phil. Trans. vol. xlviii. art. 79. p. 598, &c.

Mr. Ferguson has constructed and described a pyrometer, which makes the expansion of metals by heat visible to the 45,000th part of an inch. The upper surface of this machine is represented by fig. 7. Its frame, A B C D, is made of mahogany, on which is a circle divided into three hundred and sixty equal parts; and within that circle is another, divided into eight equal parts. If the short bar E be pushed one inch forward (or toward the centre of the circle,) the index *e* will be turned 125 times round the circle of 360 parts or degrees. As 125 times 360 is 45,000, it is evident, that if the bar E be moved only the 45,000th part of an inch, the index will move one degree of the circle. But, as in this pyrometer the circle is nine inches in diameter, the motion of the index is visible to half a degree, which answers to the 90,000th part of an inch in the motion or pushing of the short bar E.

One end of a long bar of metal F is laid into a hollow place in a piece of iron G, which is fixed to the frame of the machine; and the other end of this bar is laid against the end of the short bar E, over the supporting cross-bar H I: and, as the end, *f*, of the long bar is placed close against the end of the short bar, it is plain that if F expands, it will push E forward, and turn the index *e*.

The machine stands upon four short pillars, high enough from a table, to let a spirit lamp be put on the table under the bar F; and, when that is done, the heat of the flame of the lamp expands the bar, and turns the index.

There are bars of different metals, as silver, brass, and iron; all of the same length as the bar F, for trying experiments on the different expansion of different metals, by equal degrees of heat applied to them for equal lengths of time; which may be measured by a pendulum that swings seconds. Thus,

Put on the brass bar F, and set the index to the 360th degree: then put the lighted lamp under the bar, and count the number of seconds in which the index goes round the plate, from 360 to 360 again; and then blow out the lamp, and take away the bar.

This done, put on an iron bar F where the brass one was

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was before, and then set the index to the 360th degree again. Light the lamp, and put it under the iron bar, and let it remain just as many seconds as it did under the brass one; and then blow it out, and you will see how many degrees the index has moved in the circle: and by that means you will know in what proportion the expansion of iron is to the expansion of brass; which will be found to be as 210 is to 360, or as 7 to 12. By this method, the relative expansion of different metals may be found.

The bars ought to be exactly of equal size, and to have them so, they should be drawn, like wire, through a hole.

When the lamp is blown out, you will see the index turn backward; which shews that the metal contracts as it cools.

The inside of this pyrometer is constructed as follows.

In *fig. 8.* *A a* is the short bar, which moves between rollers; and, on the side *a*, it has fifteen teeth in an inch, which take into the leaves of a pinion *B* (twelve in number), on whose axis is the wheel *C* of one hundred teeth, which take into the ten leaves of the pinion *D*, on whose axis is the wheel *E* of one hundred teeth, which take into the ten leaves of the pinion *F*, on the top of whose axis is the index above-mentioned.

Now, as the wheels *C* and *E* have one hundred teeth each, and the pinions *D* and *F* have ten leaves each, it is plain, that if the wheel *C* turns once round, the pinion *F*, and the index on its axis, will turn one hundred times round. But, as the first pinion *B* has only twelve leaves, and the bar *A a* that turns it has fifteen teeth in an inch, which is twelve and a fourth part more; one inch motion of the bar will cause the last pinion *F* to turn one hundred times round, and a fourth part of one hundred over and above, which is twenty-five. So that if *A a* be pushed one inch, *F* will be turned one hundred and twenty-five times round.

A silk thread *b* is tied to the axis of the pinion *D*, and wound several times round it; and the other end of the thread is tied to a piece of slender watch spring *G*, which is fixed in the stud *H*. So that as the bar *f* expands, and pushes the bar *A a* forward, the thread winds round the axle, and draws out the spring; and as the bar contracts, the spring pulls back the thread, and turns the work the contrary way, which pushes back the short bar *A a* against the long bar *f*. This spring always keeps the teeth of the wheels in contact with the leaves of the pinions, and so prevents any shake in the teeth.

In *fig. 7.* the eight divisions of the inner circle are so many thousandth parts of an inch in the expansion or contraction of the bars; which is just one thousandth part of an inch for each division moved over by the index. Ferguson's Lectures on Mechanics, Supplem. p. 7, &c. 4to.

Another pyrometer was invented by M. De Luc, in consequence of a hint suggested to him by Mr. Ramsden. The basis of this instrument is a rectangular piece of deal board two feet and a half long, fifteen inches broad, and one inch and a half thick, and to this all the other parts are fixed. This is mounted in the manner of a table, with four deal legs, each a foot long, and an inch and a half square, well fitted near its four angles, and kept together at the other ends by four firm cross-pieces. This small table is suspended by a hook to a stand; the board being in a vertical situation in the direction of its grain, and bearing its legs forward in such a manner as that the cross-pieces which join them may form a frame, placed vertically facing the observer. This frame sustains a microscope, which is firmly fixed in another frame that moves in the former by means of grooves, but with a very considerable degree of tightness; the friction of which may be increased by the

pressure of four screws. The inner sliding frame, which is likewise of deal, keeps the tube of the microscope in a horizontal position, and in great part without the frame, inasmuch that the end which carries the lens is but little within the space between the frame and the board. This microscope is constructed in such a manner as that the object observed may be an inch distant from the lens; and it has a wire which is situated in the focus of the glasses, in which the objects appear reversed. At the top of the apparatus there is a piece of deal, an inch and a half thick, and two inches broad, laid in a horizontal direction from the board to the top of the frame. To this piece the rods of different substances, whose expansion by heat is to be measured, are suspended: one end of it slides into a socket, which is cut in the thickness of the board, and the other end, which rests upon the frame, meets there with a screw, which makes the piece move backwards and forwards, to bring the objects to the focus of the microscope. There is a cork very strongly driven through a hole bored vertically through this piece; and in another vertical hole, made through the cork, the rods are fixed at the top; so that they hang only, and their dilatation is not counteracted by any pressure. In order to heat the rods, a cylindrical bottle of thin glass, about twenty-one inches high, and four inches in diameter, is placed in the inside of the machine, upon a stand independent of the rest of the apparatus. In this bottle the rods are suspended at a little less than an inch distance from one of the sides, in order to have them near the microscope. Into this bottle is poured water of different degrees of heat, which must be stirred about by moving upwards and downwards, at one of the sides of the bottle, a little piece of wood fastened horizontally at the end of a stick: in this water is hung a thermometer, the ball of which reaches to the middle of the height of the rods. During these operations the water rises to the cork, which thus determines the length of the heated part; the bottle is covered to prevent the water from cooling too rapidly at the surface; and a thin case of brass prevents the vapour from fixing upon the piece of deal to which the rods are fixed. This pyrometer is represented in *fig. 9*, in which *aa* is the stand to which it is suspended; *b* the hook from which it hangs; *ccc* the deal-board, which is the basis of the whole apparatus; *d, d, d, d*, four arms, to which is fixed the frame *eeee*: the other frame which carries the microscope is *ssss*: *g, g*, are two cross-pieces, through which passes the tube of the microscope, and which support it near both ends; *hh* is the microscope; *i* its micrometer; *k* the cork, through which passes the glass rod *ll*, and by which it is kept suspended; *m* a rod of metal, or any other substance less dilatable than glass; *n* the point of union, obtained by means of two connected rings, in which both rods are fastened by screws: above these is another pair of rings, in one of which the metal rod is free, and which rod it supports; *op* the piece to which the glass rod is suspended; *q* a square piece fixed to the frame by four screws, behind which is a box, in which, as well as in a groove cut in the basis in *p*, the piece *op* slides; *r* a screw, which passes through the square piece *q*, whose use is to move backwards or forwards the piece *q*, in order to bring the surface of the metal rod to the focus of the microscope: *s, s, s, s*, four screws, with round metal plates behind their heads, which serve to press the frame of the microscope against the frame *eeee*; the longitudinal openings, through which the screws pass, permit the free motion of the first frame, when one strikes gently with a hammer to the bottom or the top of one of the sides. If the microscope is wanted higher or lower than the grooves permit, the screws may be removed

moved to other holes made on purpose in the side pieces or the frame *cccc*: *tttt* is the cylindrical bottle, in which hang the rods in order to be heated at different degrees by water of various temperatures; *u, u,* are the supporters of the bottle; *x* the thermometer suspended in the water; *yy* a rod, to the lower end of which is fixed a small plate, to stir the water, by moving it up and down; *z z* a syphon, one branch of which is within, and the other without, the bottle, the latter being furnished with a cock, which serves to draw off the quantity of water that is necessary for changing the temperature in the bottle. For a farther account of this instrument, together with the principle of its construction and use, both in the comparative measure of the expansions of bodies by heat, and the measure of their absolute expansion, and the experiments made with it, we must refer to an elaborate essay of M. De Luc on Pyrometry, &c. in the Phil. Transf. vol. lxxiii. part i. art. 20. p. 419—546.

All the contrivances above described must be considered as inferior to that constructed by Mr. Ramsden, of which general Roy has given an accurate and minute account in the Phil. Transf. vol. lxxv. p. 462. We shall here give such an account as our limits will allow of this instrument, the construction of which is so accurate, says major-general Roy, that it seems not easy to improve it; and refer for a fuller account illustrated by appropriate drawings. This pyrometer, named the *microscopic*, because by means of two microscopes attached to it, the expansion is measured, consists of a strong deal frame, 5 feet long, nearly 28 inches broad, and about 42 inches in height. The metallic bar, whose expansion is to be measured, and which may be even five feet long, is placed in a copper trough little longer than five feet; and this is placed over 12 spirit lamps, the flames of which heat the water of that trough fully to the boiling point, and of course heat the bar which is plunged into it. Two other wooden troughs, also full of water, are placed parallel to, and at a little distance from, the copper one. Each of these contains a cast-iron prismatic bar. To the ends of one of these bars two microscopes are fastened in an horizontal situation, perpendicularly to the bars. One of these microscopes is furnished with a micrometer, or mechanism, to measure the magnified image of an object; the other microscope has a simple mark. The parts of the microscopes, as well as the proper marks for measurement, are so separated and disposed, partly upon the ends of the cast-iron rods, and partly upon the ends of the rod under examination, that if any of them be lengthened or shortened, that alteration is clearly perceived through the microscopes, and may be measured by means of the micrometer. It follows, that if the temperature of the cast-iron prismatic bars be kept unaltered, whilst that of the bar under examination is increased, then the increase of length, which is measured by the micrometer, must be attributed to that bar only, and by these means the expansions of seven substances were ascertained. For further particulars relating to the construction and use of this instrument, we refer to the Transactions (ubi supra), and to the article EXPANSION in this Cyclopædia. For an account of Wedgwood's pyrometer, see THERMOMETER. Also, for a description of Mr. Troughton's pyrometer, we are under the necessity of referring to the same article.

PYROMUCOUS ACID, or *Empyreumatic acid of sugar*, or *Syrupous acid*, is different from the acid of sugar, or *Oxalic Acid*, (which see,) and denotes that pungent acid vapour of sugar, or any saccharine matter strongly heated, which is familiar to every person who has ever entered a sugar baking-house. It is prepared by chemists in the following manner: Put into a very large glass retort any

quantity of pulverized sugar of any kind, so as to fill only $\frac{1}{4}$ th of it, as the matter very much swells in the process: adapt to it a large receiver, not closely luted, and heat it gradually on a sand-bath. A great quantity of gas arises when the sugar begins to be scorched, which is mostly carbonic acid mixed with an inflammable gas, probably the gaseous oxyd of carbon. In the receiver is condensed a weak acidulous liquor, coloured by an oily matter, and also apparently fouled by a portion of fuliginous matter volatilized during the distillation. The quantity of acid, obtainable in this process, varies according to the regulation of the fire, which should at least be pushed so as to make the retort red-hot, and to reduce the sugar to a perfect charcoal; but in general about $\frac{1}{4}$ ths of the weight of sugar may be obtained of the distilled acid. Gum mucilage, manna, honey, starch, and other mucous or mucoso-saccharine substances, yield, by distillation, the same acid as sugar. Aikin, Dict. Min.

PYRONOMIA, a term used by the chemical writers to express the art of regulating fire, so as to make it subservient to all their processes in a determinate degree.

PYROPE, in *Mineralogy*, a precious stone, formerly called the Bohemian garnet. (See GARNET.) The colour is a dark blood red: when held between the eye and the light, the red colour inclines to a yellow. The pyrope is never found crystallized, but occurs in small round or angular fragments imbedded in serpentine rock, or scattered in the sands on the sea-shore, and in alluvial ground. It scratches quartz. The specific gravity is stated by Klaproth 3.718. On account of its lustre, transparency, colour, and hardness, it is much prized by jewellers. The small grains, when powdered, are applied to cut softer stones. According to Klaproth, the constituent parts of pyrope are

Silex	-	-	40.0	
Alumine	-	-	28.50	
Magnesia	-	-	10.00	
Lime	-	-	3.50	
Oxyd of iron	-	-	16.50	
Oxyd of manganese	-	-	0.25	
Loss	-	-	1.25	B.

PYROPHAGI. See FIRE-Eaters.

PYROPHANES, in *Mineralogy*, a variety of the femiopal; so called because, being heated in a spoon, it becomes transparent, but returns to its opaque state when cold, as Mr. Landriani has discovered. M. Saussure, junior, renders common hydrophanes transparent, and of a topaz colour, when heated by digesting them in melted wax. It is said that some pyrophanes are found in Armenia, which are transparent while exposed to the sun, and opaque at night. See GEM.

PYROPHORUS, formed of *πῦρ*, fire, and *φέρω*, I bear, in *Chemistry*, the name usually given to that substance called by some *black phosphorus*; a chemical preparation possessing the singular property of kindling spontaneously when exposed to the air.

This substance was accidentally discovered by M. Homberg, who prepared it of alum and human feces. (See PHOSPHORUS *Fæcalis*.) See also M. Le Fevre's preparation, described under PHOSPHORUS of Sulphur.

It was apprehended for a considerable time after the discovery, that human feces were essential to the operation, till the youngest son of the great Lemery found, that honey, sugar, flour, and, indeed, any animal or vegetable matter, might be substituted instead of the human feces; and since that time, M. de Suvigny has shewn that moist vitriolic salts may be substituted for the alum; having added to the alu-

PYROPHORUS.

minous pyrophorus of Homberg two other classes of substances of this kind, viz. the metallic, or those made with the three vitriols of iron, copper, and zinc; and the neutral, or those composed of vitriolated tartar and Glauber's salt.

The aluminous pyrophorus may be made in the following manner. Take four or five parts of alum, and one part of wheat flour, or any animal or vegetable substance; calcine these together to a brown or blackish mass: powder the mass, and put it into a phial; stop it loosely with paper, and set it in a sand heat, so as to make it continue glowing-hot for some time; after this remove the whole from the fire, set it to cool gradually, and finally stop the bottle very close down.

The following process is recommended by Macquer for this preparation. Let three parts of alum and one part of coarse brown sugar be mixed together. This mixture must be dried in an iron ladle or shovel over a moderate fire, till it be almost reduced to a blackish powder or coal; during which operation it must be stirred with an iron spatula. Any large masses must be bruised into powder, and then it must be put into a glass matrafs, the mouth of which is rather straight than wide, and its length seven or eight inches. This matrafs is to be placed in a crucible, or rather earthen vessel, large enough to contain the belly of the matrafs, with about a space equal to the thickness of a finger all round it. The space is to be filled with sand, so that the matrafs shall not touch the earthen vessel: the apparatus is then to be put in a furnace, and the whole to be made red-hot; the fire must be gradually applied, that any oily or fuliginous matter may be expelled. After which, when the matrafs is made red-hot, sulphureous vapours exhale: this degree of heat is to be continued till a truly sulphureous flame, which appears at the end of the operation, has continued nearly a quarter of an hour: the fire is then to be extinguished, and the matrafs to cool without taking it out of the crucible; and when it ceases to be red-hot, it must be stopped with a cork. Before the matrafs is perfectly cold, it must be taken out of the crucible; and the powder it contains must be poured into a very dry glass phial, which must be well closed with a glass stopper. If we would preserve this pyrophorus a long time, the bottle containing it must be opened as seldom as possible. Sometimes it kindles while it is poured into the glass phial, but it may be then extinguished by closing the phial expeditiously.

Another excellent method of preparing pyrophorus, cited by Aikin from Higgins's Minutes, is the following. Mix together three parts of Roman alum, and one of flour, and heat the mixture to dryness in an iron pot, as already described: the black calcined mass thus produced is to be put into ounce phials of green glass, coated without and within with clay. The phials thus charged are to be lightly stopped with balls of tempered clay, and then set up to their necks in sand in an iron pot; charcoal powder is then to be strewn on to the depth of half an inch, over which is to be placed an earthen cover, luted to the pot. The whole apparatus is now to be placed in a furnace, and kept at a red heat for an hour and a half; at the expiration of which period, being taken out of the furnace and cooled quickly, it is to be unpacked, and the phials containing the pyrophorus are to be placed with their mouths inverted in mercury, in which situation the pyrophorus may be kept for many years without injury.

When half a drachm of this pyrophorus is put on a piece of paper and exposed to air, it quickly kindles, becomes red like burning coals, emits a strongly sulphureous vapour, and burns the paper or other combustible body which sup-

ports it: and nothing is left but the white earthy base of the alum. When no sensible change takes place in the pyrophorus, either from a defect in the preparation, or from some air remaining in the phial that contains it, the combustion may be effected by breathing on the powder, and thus supplying it with the moisture which seems to be the primary agent in this phenomenon. The pyrophorus that is made in the last method we have recited is so highly inflammable as to take fire while it is falling from the mouth of the phial. If it be poured into a jar of pure oxygen gas, it forms a brilliant fiery shower: the oxygen is for the most part consumed, and there remain in the jar sulphureous acid and carbonic acid gases: the pyrophorus also being consumed with the exception of its aluminous base.

The spontaneous accention of the aluminous pyrophorus, on its being exposed to the air, has been a subject of considerable discussion among chemists and philosophers; several of whom have adopted the hypothesis proposed by M. de Suvigny, in the *Memoires de Mathematique et de Physique*, tom. iii. To explain this curious appearance, M. de Suvigny observes, that the vitriolic acid in the alum, during the calcination in the phial, leaves its earthy basis, and unites with the phlogiston in the coal. By its union with this inflammable matter, a part of it is undoubtedly rendered volatile, and exhales partly under the form of volatile vitriolic acid, and partly in that of a blue sulphureous flame; while another part of it combines likewise with the phlogiston forming a real sulphur, or an earthy hepar sulphuris; in which the sulphur is protected from the fire by the earth with which it is combined, and the particles of which remain every where intermixed with those of the powder. Thus far (says Mr. Bewly, an excellent chemist and philosopher) M. de Suvigny is supported by the appearances, and by a just chemical analysis of the powder: but he proceeds farther, and supposes that, at the end of the process, a part of the vitriolic acid is left in a disengaged, or uncombined state, and highly concentrated. In this state it is well known that this acid attracts moisture, and at the same time generates a considerable degree of heat. When the pyrophorus, therefore, is exposed to the air, he again supposes that this disengaged and concentrated acid suddenly attracts the watery particles floating in the atmosphere, and by the heat thus generated, sets fire to the sulphur and other inflammable matter contained in the powder. This hypothesis he has endeavoured to establish by the following observations; that the pyrophorus, as he apprehends, can be made only with substances fit for producing sulphur, or with sulphur itself:—that no pyrophorus will be produced, if the mixture be calcined by too long or too violent a fire; because then the whole vitriolic acid can be combined into perfect sulphur, and consequently is engaged, and not in a proper state to attract the moisture of the air; or else if it does not combine into sulphur, being half disengaged from its basis, it is driven off by the violence or long continuance of the fire; and, consequently, after this complete calcination, no acid remains partly disengaged, as it ought to be, that it might unite with the water with sufficient activity:—that when the pyrophorus is very slowly moistened, as when it is kept in a bottle not well closed, it does not kindle, because sufficient heat is not produced by this slow and gradual attraction of water; it is also spoiled and rendered incapable of kindling, when exposed to the open air; because its acid becomes then saturated, or nearly saturated with moisture, and cannot, therefore, unite with that of the air with sufficient activity:—that a pyrophorus, thus spoiled by exposure to moisture, may be restored to its peculiar properties by making it again red-hot in a matrafs; since by this calcination its partly-

disengaged acid is again concentrated, and resumes all its force of combining with water;—and, lastly, that the inflammation of the pyrophorus is accelerated by placing it upon a paper a little wetted, or by breathing upon it; because the acid then attracts the moisture more hastily, and consequently with more heat.

M. de Suvigny extends the same reasoning to the several other pyrophori which he discovered, similar to that of alum; particularly to those which are made by substituting vitriolated tartar, Glauber's salt, and other vitriolic salts with metallic, earthy, or alkaline bases, in the room of alum. Mr. Bewly has examined this hypothesis with his usual acuteness and accuracy; and from numerous well-conducted experiments he is led to conclude, that pyrophori of all the above-mentioned classes may be prepared, differing from them in no other particular, except that they contain no vitriolic acid, and which nevertheless kindle as readily, on being exposed to the air, as those which have been impregnated with that principle. In order to shew that the presence of vitriolic acid is not necessary to constitute the pyrophorus made with vitriolated tartar, he added to a quantity of this tartar more than an equal weight of powdered charcoal, and calcined the mixture a long time, in a red heat, in an open crucible; frequently stirring the powder, in order to expel from it as much of the vitriolic acid as possible; the calcination was also sometimes repeated with fresh charcoal: and yet on heating the salt, thus deprived of a considerable part of its acid, with charcoal, in a crucible or tobacco-pipe, in the manner which we shall here subjoin, he observed no diminution in its quality of producing a pyrophorus.

Mr. Bewly, in several of his experiments, made use of the bowl of a tobacco-pipe, in which he combined the materials, which he wished to examine in small quantities, and in an expeditious manner; pressing them down slightly, so as to fill half or three-fourths of the bowl, and filling the remainder of it with fine sand. This is kept in a red heat twenty minutes, or half an hour; or it may continue there two hours longer, if the operator pleases, without any injury to the pyrophorus. The pipe being taken out of the fire, the matter is knocked out of it as soon as it becomes cool, and generally, pretty soon afterwards, takes fire spontaneously. Thus he formed his pyrophorus with a mixture consisting of two parts of alum, previously calcined in a red heat; and of powdered charcoal and salt of tartar each one part.

In another experiment, having added successively various and increasing quantities of fixed alkali to the salt heated as above, till the vitriolic acid contained in the mixture might be considered nearly as an evanescent quantity, a pyrophorus was still produced on calcining it with charcoal as before. He also mixed equal parts of salt of tartar, and vegetable or animal coal, or sometimes three parts of the former with two of the latter, and calcined them in the usual manner; and this composition, on being exposed to the air, generally kindled in half a minute or a minute; though, as it contained no sulphur, it did not burn with so much vivacity as the vitriolic pyrophori. This, which Mr. Bewly calls the alkaline pyrophorus, differs in no circumstance from M. de Suvigny's neutral pyrophori, except in its not containing that principle to which he ascribes their accession. However, lest it might be suspected that the salt of tartar which he employed might accidentally contain vitriolated tartar, or vitriolic acid, he repeated the experiment with tartar calcined by himself, as well as with nitre fixed or alkali-fied by deflagration with charcoal, and with iron filings; and in all these cases with the same result. By diversifying in a like manner M. de Suvigny's experi-

ments on the metallic pyrophori, Mr. Bewly found that none of the three vitriols, heated with charcoal alone, in his usual method, could produce a pyrophorus. And thus he found that the addition of an alkaline salt to the composition, which was a part of M. de Suvigny's process, was essential to its success.

Treating in the usual manner equal parts of calcined green vitriol and charcoal, the powder which contained no sulphur nor *hepar sulphuris*, did not acquire any of the properties of a pyrophorus. The vitriolic acid seemed to have been entirely dissipated; having no haste to detain it, when dislodged from the metallic earth. The charcoal and calx of iron, left in this process, were calcined again, together with some salt of tartar; and a pyrophorus was produced, which exhibited indications of its containing a scarcely perceptible portion of *hepar sulphuris*. Thirty grains of *crocus martis astringens* were calcined with fifteen grains of charcoal, and the same quantity of salt of tartar; and the mixture burnt spontaneously, though it contained no *hepar sulphuris*, or vitriolic acid. Having by these experiments evinced that metallic pyrophori may be prepared without vitriolic acid, Mr. Bewly proceeded to form an aluminous pyrophorus of the same kind. For this purpose, he procured the earth of alum by a long and violent calcination; and examining a part of it, he found, by the usual tests, that it neither contained any sulphur, *hepar sulphuris*, nor alum undecomposed. This he considered as perfectly pure, though he afterwards found that it contained a small quantity of vitriolated tartar: and yet it repeatedly furnished a pyrophorus as active as when alum itself is employed. From these and similar experiments he infers, that the several kinds of pyrophori are not kindled by moisture attracted by the vitriolic acid, as M. de Suvigny has maintained: and his conclusion is farther confirmed by some experiments of Dr. Priestley, from which it appears, that they are kindled in dry, nitrous, and dephlogisticated air.

M. Proust, cited by Mr. Bewly, describes a variety of new pyrophori, which neither contain vitriolic acid, nor seem likely to owe their accession to the attraction of humidity from the air. These principally consist of a coaly matter simply divided by metallic or other earths; such are the sediment left on the filter in preparing Goulard's extract, various combinations of tartar, or its acid, or the acetous acid, with metals, calcareous earth, &c.

Mr. Bewly, having evinced the insufficiency of M. de Suvigny's theory, and discovered that the pyrophori are not kindled by moisture, attracted (merely) by the vitriolic acid, directed his attention to the nitrous acid, which Dr. Priestley has shewn to be a constituent part of atmospheric air, as the probable agent in the production of this phenomenon. The strong affinity which this acid has with phlogiston, and the heat, and even flame, which it is known to produce with certain inflammable matters, manifested that it was equal to the effect; and having excluded the vitriolic acid from having any essential concern in this operation, he suggests, either that the pyrophorus is kindled by moisture attracted by some of the other ingredients which compose it; or that it has the power of decomposing atmospheric air, by suddenly attracting its nitrous acid, and thereby generating a heat sufficient to kindle the phlogistic matter contained in it. This idea appeared plausible, when he farther considered that Dr. Priestley produced the purest respirable air with this same acid combined with other principles; and that this as well as common air is diminished, and probably in part decomposed, in a variety of phlogistic processes. This ingenious writer concludes, upon the whole, from the experiments he hath made, that the pyrophorus seems to owe its singular

lar property to its being a combination of earth or alkali with phlogiston; the vitriolic acid, when present, only occasionally increasing or diminishing the effect, according to circumstances. In the process of calcination, the earth or alkaline principle is not merely mixed, but actually, though loosely, combined with the phlogistic principle of the coal; so that the pyrophorus, considering it in its most simple state, is only a perfectly dry phlogisticated alkali or earth. On these data, the phenomena may be explained in the two following methods; with respect particularly to the influence of moisture and heat upon the pyrophorus. Supposing either the alkaline or earthy principles to have a greater affinity to water than to the phlogiston with which either of them is united, they may, on being exposed to a moist atmosphere, attract the humidity, and therefore set the phlogistic principle at liberty; which may, in its turn, attract and be ignited by, the supposed aerial acid, its strong affinity to which is well known:—or, if this hypothesis be rejected, the inflammable matter may be kindled, merely in consequence of the heat produced by the combination of the alkali, &c. with moisture. This reasoning, however, supposes the existence of phlogiston, which modern chemists have generally exploded.

The chemical changes that take place during the formation and decomposition of pyrophorus, as they are stated by Aikin, appear to be the following: 1. By being heated below redness in the open air, the ingredients enter into fusion, and thus mix accurately with each other; then the water of crystallization is driven off from the alum, and of the fugar or flour, little else than the charcoal escapes volatilization. 2. The red heat to which it is exposed in the phial causes the sulphuric acid of the alum and charcoal of the fugar to re-act on each other, by which part of the charcoal is driven off in the form of carbonic acid, and part of the sulphuric acid escapes as sulphureous acid. The blue flame that characterizes the latter part of this process is probably caused by the volatilization and combustion of a portion of sulphur, more than is requisite to saturate the potash of the alum. Thus the pyrophorus, when prepared, consists of alumine, charcoal, and sulphuret of potash in intimate mixture. 3. When this powder is exposed to the air, a rapid decomposition of the air itself, and of the moisture which it contains, takes place, the oxygen of each being absorbed by the sulphuret, while a sufficient quantity of heat is disengaged, to bring the charcoal and remainder of the sulphur to a state of actual inflammation. See on the subject of this article, Macquer's Chemical Dict. art. Pyrophorus; and Priestley's Obs. on Air, vol. iii. Appendix, p. 386, &c. vol. iv. Appendix, p. 479, &c. Aikin's Dictionary.

PYROPHYLACIA, a term used by Kircher and some others, to express those magazines of fire which are placed in the cavities of mountains and other hollows of the earth, and serve to supply the several volcanoes in the different parts of the world. See **VOLCANO**.

PYROPHYSALITE, in *Mineralogy*, is so called from *πυρ*, fire, and *φυσάλη*, a bubble, because this mineral emits bubbles when exposed to the flame of the blowpipe. It is found at Finbo, near Fahlun, in Sweden, imbedded in a granitic rock. The colour of pyrophyalite is white, inclining to green, and occasionally small spots of blue fluor spar are seen on its surface. It commonly occurs in oblong pieces, some of which approach to an irregular rhomboid. It differs from feldspar, to which it has the most resemblance, in having but one determinate direction in which it can be split; its specific gravity is also greater, and it fuses more easily. The fragments scratch glass, but are less hard than quartz. The powder of the finest fragments emit a phosphorescent light when heated. Its specific gravity is 3.45,

and the constituent parts, according to Hefinger and Berzelius, are

Alumine	-	53.5
Silex	-	32.88
Lime	-	.88
Oxyd of iron	-	.88
Volatile matter	-	.75
Loss	-	11.26

The substance lost during the process is suspected to be fluoric acid. Häuy classes this mineral with the topaz. See **TOPAZ**. B.

PYROPECILOS, in the *Natural History of the Ancients*, the name by which they call the granite of Arabia, commonly known to this day under the name of the Oriental granite.

The name is derived from the Greek, *πυρ*, fire, or fire-coloured, and *ποικιλος*, spotted; and the ancients having used the epithet fiery to yellow, as well as red, some have imagined the granite must be a yellow stone; but it is evident that red is the colour meant by it here.

PYROSCOPE, an instrument invented by professor Leslie for measuring the intensity of fire. This is merely the *differential THERMOMETER* (which see), with one of its balls covered with silver leaf, while the other is naked. The fire heats the naked ball, but not the silvered ball. Hence the liquid in the tube rises or falls, according to the intensity of the fire, and of course marks that intensity.

PYROSCOPIA, formed of *πυρ*, fire, and *σκοπεω*, I consider, among the Greeks, a kind of divination, being the same with pyromancy and ignispicium.

PYROSIS, in *Medicine*, called in Scotland the *water-brash*, is a disorder of the stomach, which is characterized by a sudden and violent attack of pain in that organ, followed by a copious discharge of a colourless, insipid, and generally cold fluid, resembling saliva, from the œsophagus, mouth, and throat.

The first description of this disease was given by Linnæus, as a common affection of the Laplanders, under the appropriate appellation of *Cardialgia sputatoria*; whence Sauvages gave it the denomination of *pyrosis Suecica*. (Nosol. Meth. class vii. gen. 18.) Dr. Cullen adopted the generic term *pyrosis*, and deems it an idiopathic disease. It seems to occur, however, in conjunction with other forms of indigestion, and might have been arranged as one of the symptoms of *dyspepsia*.

The fits of *pyrosis* usually come on in the morning and forenoon, when the stomach is empty. The first symptom is a pain at the pit of the stomach, with a sense of constriction, as if the stomach were drawn towards the back: the pain is increased by raising the body into an erect posture, and therefore the patient bends himself forward. This pain is often extremely severe, with a sense of burning; and after continuing for some time, it brings on an eructation of a thin watery fluid in considerable quantity. This fluid has sometimes an acid taste; but most commonly it is described as being absolutely insipid. It continues to be brought up for some time, and does not immediately give relief to the pain which preceded it; but at length it terminates the pain, and the fit ceases.

These paroxysms come on without any evident cause, nor is the origin of the disease always to be imputed to any particular sort of diet. It seldom, if ever, attacks those people who use fresh animal food daily; but appears to be most common among those who live almost entirely upon tea, milk, potatoes, and farinaceous substances. It is much more

common in women than in men; sometimes it attacks pregnant women, and often those who labour under leucorrhœa. It seldom occurs in any one before the age of puberty, or in those who are considerably advanced in life: when it has once taken place, it is very prone to recur occasionally for a long time afterwards. It is more common in Scotland than in this country, and chiefly affects the lower classes of the people.

While the same diet is continued, it is not always easy to cure the disease. The paroxysm is most effectually relieved by anodynes, especially opium; hyoscyamus, conium, &c. answer a similar purpose; and with less certainty; other stimulants and antispasmodics, as sulphuric æther, ammonia, the tincture of guaiacum, &c. alleviate the fit. These remedies, however, do not materially contribute to prevent the recurrence of the paroxysms; and bitters, aromatics, and the whole of remedies against indigestion, have been often employed in vain. A combination of aromatic laxatives, with strong alkalies and narcotics, have appeared to the writer of this article to be on the whole the most effectual remedies. See Cullen, First Lines, vol. iv. p. 1.

Pyrosis is also a word used to express an intense heat and redness in the face, such as that of persons who travel in extremely hot weather, and the like.

PYROSTRIA, in *Botany*, so called by Commerſon, from the pear-shaped striated fruit.—Juss. 206. Willd. Sp. Pl. v. 1. 614. Lamarck Illustr. t. 68.—Class and order, *Tetrandria Monogynia*. Nat. Ord. *Rubiaceæ*, Juss.

Gen. Ch. Cal. Perianth superior, short, in four deep, acute, broad segments, deciduous. Cor. of one petal, somewhat bell-shaped; tube thrice as long as the calyx, swelling gradually upwards; limb of the same length, in four acute, equal, spreading segments; throat downy. Stam. Filaments four, short, inserted into the tube of the corolla, alternate with the segments of the limb; anthers oblong, erect, pointed, shorter than the limb. Pist. Germen turbinate, inferior; style short, cylindrical; stigma capitate. Peric. Berry small, dry, pear-shaped, with eight furrows, and eight cells, destitute of any crown. Seeds solitary in each cell.

Eff. Ch. Calyx four-toothed. Corolla bell-shaped, four-cleft, downy in the throat. Berry inferior, obovate, with eight furrows and eight seeds.

Obf. Jussieu, by an error which seems typographical, attributes five segments to the corolla, which Willdenow copies. There are, however, but four, as the analogy of the other parts, in this case, necessarily requires.

1. *P. salicifolia*. Willow-leaved Streak-berry. Willd. n. 1. (*Pyrostria olæoides*; Lamarck Illustr. v. 1. 289. t. 68. f. 2, (not f. 4).—Gathered by Commerſon, in the isle of Bourbon; not, as Willdenow has it, the Mauritius. A shrub, with round, smooth, greyish, leafy branches. Leaves opposite, on short stalks, rather crowded, two or three inches long, elliptic-lanceolate, sharpish, entire, coriaceous, smooth, with one rib, and several lateral incurved veins, occasionally accompanied by an axillary gland-like tubercle, that seems accidental; paler beneath. Stipules between the footstalks, and of the same length, awl-shaped, erect, dilated at the base, deciduous. Flower-stalks axillary, solitary, somewhat umbellate, bearing one or more simple, single-flowered, partial stalks, with a pair of oblong tapering bractæ at the base of the latter. Flowers hardly a quarter of an inch long, erect, apparently white. Fruit, according to Lamarck, near an inch in length, pear-shaped, umbilicated, with eight deep longitudinal furrows. When cut transversely, it shews the eight seeds, compressed, and radiating from the centre.

PYROTARTAREOUS ACID, or *Empyreumatic acid of tartar*, a species of empyreumatic acetic acid, very different from TARTAREOUS acid; which see. To procure this acid, distil any quantity of cream of tartar in a glass or earthen retort, as in the process for PYROMUCOUS Acid: the retort being half full of the tartar, on raising the fire very slowly, the first produce is a limpid, acidulous, somewhat bitterish water, after which, as the heat increases, a most prodigious volume of the inflammable gas is given out, together with a stronger acid, and more empyreumatic liquid, and at last a black oil, and some volatile alkali.

The whole quantity of liquid acid procured from tartar in this method, is generally not more than about a quarter of the weight of the tartar, and is not quite so brown, nor so highly empyreumatic as the *pyromucous*. This acid, and also the pyroligneous and pyromucous acids, are capable of very considerable purification by easy methods, so that they lose their empyreuma, their peculiar taste and smell, in which consist their characteristic differences; till at last, when brought into the most concentrated state by some of the modes in which vinegar is dephlegmated, they exhibit the characters of acetic acid so unequivocally, that no doubt can be entertained of their identity. Simple rectification, or redistillation in a very gentle heat, and stopping the process when the liquor at last comes over much coloured, will purify, to a very great degree, the pyromucous and pyroligneous acids: the latter, by this process, from being of a dark coffee colour, assumes the hue of very pale clear brandy. But on long exposure to light, it again becomes brown, for it retains its empyreumatic character more than any other. Charcoal, newly burnt and powdered, contributes very much to the purification of all these acids; they may be either gently distilled off it, or even merely filtered through a stratum of it. But the most effectual method of purification is by uniting these acids with lime, or a fixed alkali, evaporating to dryness, and then expelling the acid by means of the sulphuric acid, in the same manner as the concentrated vinegar is prepared. The acid vapour that rises in this process has now lost its empyreuma almost entirely; has both the strength and the powerful odour of radical vinegar; when again united to potash, forms acetated potash, which may be obtained white by repeated crystallization, or by charcoal powder, and in short is perfect acetic acid. Aikin.

PYROTECHNY, derived from the Greek words πυρ, *fire*, and τεχνη, *art*, is a term applied to the art or science which teaches the management and application of fire in certain operations. Although this term has been used in a very extensive sense by some writers, and applied to the use and structure of fire-arms and artillery employed in the art of warfare, yet it is commonly confined, as it will be in this work, to those articles and instruments made use of for amusement, and for grand public occasions, as the celebration of victories, the demonstrations of public joy on account of peace, after long continued war, &c.

Of the origin of artificial fire-works there is nothing certain recorded. In Europe the invention of them is of recent date, and is given to the Italians. The use of fire-works in China was very general long before they were known in European countries: and from an account given of some recent exhibitions at Peking, it should seem that they have attained to a degree of perfection not surpassed even by the artists of England, France, or Italy. "The fire-works, in some particulars," says Mr. Barrow in his Travels in China, "exceeded any thing of the kind I had ever seen. In grandeur, magnificence, and variety, they were, I own, inferior to the Chinese fire-works we had seen at Batavia, but infinitely superior in point of novelty, neatness,

neatness, and ingenuity of contrivance. One piece of machinery I greatly admired; a cleft five feet square was hoisted up by a pulley to the height of fifty or sixty feet from the ground: the bottom was so constructed as then suddenly to fall out, and make way for twenty or thirty strings of lanterns enclosed in a box to descend from it, unfolding themselves from one another by degrees, so as at last to form a collection of full 500, each having a light of a beautifully coloured flame burning brightly within it. This devolution and development of lanterns were several times repeated, and, at every time, exhibited a difference of colour and figure. On each side was a correspondence of smaller boxes, which opened in like manner as the others, and let down an immense net-work of fire, with divisions and compartments of various forms and dimensions, round and square, hexagons, octagons, &c. which shone like the brightest burnished copper, and flashed like prismatic lightning with every impulse of the wind. The diversity of colours with which the Chinese have the secret of clothing fire seems one of the chief merits of their pyrotechny. The whole concluded with a volcano, or general explosion and discharge of suns and stars, squibs, crackers, rockets, and granadoes, which involved the gardens for above an hour in a cloud of intolerable smoke."

The apparatus used in making fire-works consists of solid wooden cylinders, called formers, for rolling the cases on; similar cylinders, either of wood or metal, for ramming down the composition; moulds for holding the cases while filling; a machine for contracting the cavity of the cases; another for grinding the materials; and a particular apparatus for boring some cases after they are filled.

Construction of the Cartridges for Rockets.—A rocket is a cartridge, or case made of stiff paper, which, being filled in part with gunpowder, saltpetre, and charcoal, rises of itself into the air when fire is applied to it. There are several kinds and sizes of rockets, but the three following are the principal: *viz.* 1. Small ones, the calibre of which is not larger than that of a bullet of a pound weight. 2. Rockets, the calibre of which is equal to the size of a ball of from one to three pounds weight. 3. Large rockets, equal to a ball of from three pounds to a hundred weight.

To give the cartridges the same length and thickness, they are put into a hollow cylinder of metal, or strong wood. This mould is not to be confounded with another piece of wood, called the former or roller, around which is rolled the thick paper employed to make the cartridge. The rule for the size of the mould and roller is this: if the calibre of the mould be divided into eight equal parts, the diameter of the roller must be equal to five of these parts; of course the vacuity between the roller and the interior surface of the mould is equal to $\frac{3}{8}$ ths of the calibre of the mould, which will be exactly filled by the cartridge.

The size of the mould is measured by its calibre; but the length of the moulds for different rockets does not always bear the same proportion to the calibre, the length being diminished as the calibre is increased. In small rockets, the length of the mould ought to be six times the diameter of the calibre; but in the larger sized rockets, it need not be more than between four and five times the calibre of the mould.

Large stiff paper of a peculiar kind is employed in making cartridges, and hence it has obtained the name of *cartridge-paper*. This paper is wrapped round the roller, and then cemented by means of common paste. When the cartridge is formed, the roller is drawn almost out, by turning it round, until it is distant from the edge of the

cartridge the length of its diameter. A piece of cord is then made to pass twice round the cartridge at the extremity of the roller; and into the vacuity left in the cartridge another roller is introduced, so as to leave a space between the two. By means of the cord, the cartridge must be pinched till there remains only an aperture capable of admitting an instrument called a piercer: then the cord is removed, and its place is supplied by a piece of packthread.

Besides the roller, a rod is employed to load the cartridge, which must be somewhat smaller than the roller, that it may be easily introduced into the cartridge. This rod is pierced lengthwise to a sufficient depth to receive the piercer, which must enter into the mould, and unite with it exactly at the lower part. The piercer, which decreases in size, is introduced into the cartridge through the part where it has been choked, and serves to preserve a cavity within it.

After the cartridge is placed in the mould, the prepared composition is to be poured gradually in, and rammed down with great accuracy. When the cartridge is about half filled, separate, with a bodkin, half of the folds of the paper which remains, and having turned them back on the composition, press them down, and pierce three or four holes in the folded paper, by means of a piercer, which must be made to penetrate to the composition of the rocket. These holes serve to form a communication between the body of the rocket and the vacuity at the extremity of the carriage, as it is called, or that part which has been left empty. In small rockets this vacuity is filled with granulated powder, and covered over, which serves to let them off: in those that are larger, the pot, containing stars, serpents, and running rockets, is adapted to it.

It now remains to affix the rocket to its rod, which is thus done. When it has been constructed, in the way just described, it is to be fastened to a rod of light smooth wood. Its length and weight must be proportioned to the size of the rocket; that is, it ought to be as long as to remain in equilibrium with it, when suspended on the finger, or other fulcrum, within an inch, or an inch and a half of the neck. Before it is fired, place it with the neck downwards, and let it rest on two nails, in a direction perpendicular to the horizon: and to make it ascend to a greater height, adapt to its summit a pointed cap made of stiff paper, which will serve to facilitate its passage through the air. To these rockets may be added several other things, as a petard, which is a box of tin plate filled with fine gunpowder, placed on the summit. The petard is placed on the composition, at the end where it has been filled, and the remaining paper of the cartridge is folded down over it, to keep it firm. The petard produces its effect when the rocket is in the air, and the composition is consumed. A representation of a rocket completely fitted up is given in *Plate Pyrotechny, fig. 2.*

Stars, serpents, &c. may be added to them, which is done by adjusting to the head of the rocket an empty pot or cartridge, larger than the rocket, in order that it may contain the things intended to render the exhibition the more beautiful. The following tables are necessary to those who would manufacture rockets for themselves. The first shews the size of the calibre of the mould for rockets of a pound weight and below; and the second points out the size required for the calibre of moulds of from 1lb. to 50lbs. It must be observed, that a pound rocket is that which is just capable of admitting a leaden bullet of a pound weight, and so of the rest.

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TABLE I.—Size of the Calibre of Moulds of a Pound Weight and below, to One Ounce.

Weight of Rockets in Ounces.	Diameters in Lines.
16	19 $\frac{1}{2}$
12	17
8	15
7	14 $\frac{3}{4}$
6	14 $\frac{1}{4}$
5	13
4	12 $\frac{1}{2}$
3	11 $\frac{1}{2}$
2	9 $\frac{1}{2}$
1	6 $\frac{1}{2}$

Here it is evident, that the mould of a rocket of twelve ounces in weight ought to be seventeen lines in diameter; one of five ounces will require a mould of thirteen lines in diameter. Hence we derive an easy method of finding the size when the weights are given: and if the diameter of the rocket be given, it will be equally easy to find the weight of the ball corresponding to that calibre. Thus, if the diameter be fifteen lines, it will, by the table, be seen that it corresponds to a ball of eight ounces.

TABLE II.—Size of the Calibre of Moulds, of from 1 to a 50lb. Ball.

Pounds.	Calibre.	Pounds.	Calibre.	Pounds.	Calibre.	Pounds.	Calibre.
1	100	14	241	27	300	40	341
2	126	15	247	28	304	41	344
3	144	16	252	29	307	42	347
4	158	17	257	30	310	43	350
5	171	18	262	31	314	44	353
6	181	19	267	32	317	45	355
7	191	20	271	33	320	46	358
8	200	21	275	34	323	47	361
9	208	22	286	35	326	48	363
10	215	23	284	36	338	49	366
11	222	24	288	37	333	50	368
12	228	25	292	38	336		
13	235	26	296	39	339		

By this second table, if the weight of the ball be given the size of the mould may be found: suppose it be 18 pounds, opposite to it is the number 262. Then we say by the rule of proportion (as 19 $\frac{1}{2}$: 262 :: 100: 19 $\frac{1}{2}$: 262 to the fourth term sought, *viz.* 51.09; therefore the required calibre is 52 lines nearly, or four inches and four lines, or 4 $\frac{1}{3}$ inches. But if the calibre be given in lines, the weight of the ball may be found: suppose the given calibre be 36 lines, then as 19 $\frac{1}{2}$: 100 :: 36: 184. The nearest number in the table to this is 181, which shews that the weight of the ball will be rather more than 6lbs., or, in other words, that a rocket, the diameter or calibre of which is 36 lines, is a rocket of a 6lb. ball.

The composition of the powder for rockets must be different, according to the different sizes, it being completely ascertained that what is proper for small rockets would be too strong for the larger ones.

For rockets of one or two ounces, the composition should be one pound of gunpowder, and two ounces of finely ground soft charcoal.

For rockets of somewhat larger size, the composition may be ten ounces of gunpowder, three and a half of saltpetre, and three ounces of charcoal.

If the rockets be of five or six ounces weight, then to two pounds five ounces of gunpowder, add eight ounces of saltpetre, two ounces of sulphur, six ounces of charcoal, and two ounces of iron filings.

If the rockets be from ten to twelve ounces, you may add to seventeen ounces of gunpowder, four ounces of saltpetre, three and a half of sulphur, and one of charcoal.

For rockets of a pound weight: to one pound of gunpowder add an ounce of sulphur, and three ounces of charcoal.

For rockets of from four to seven pounds: to thirty-one pounds of saltpetre, add four pounds and a half of sulphur, and ten of charcoal: and for those that are still larger, we may add to eight pounds of saltpetre, one pound four ounces of sulphur, and two pounds twelve ounces of charcoal. In all cases the ingredients are to be pounded separately, and finely sifted before they are used. Gunpowder, thus reduced from the corns in which it is manufactured, is called meal-powder.

Matches.—The matches to let off rockets are thus made. Take linen, hemp, or cotton thread, and double it eight or ten times, if intended for large rockets, or only four or five times, if to be employed for stars. When the match is thus made, dip it in pure water, and being soaked, it is to be squeezed as dry as possible. Mix some gunpowder with a little water, so as to reduce it to a kind of paste, and immerse the match in it, turning and twisting it till it has imbibed a sufficient quantity of gunpowder; then sprinkle it over with dry powder, and when it is dry, it is fit for use.

In answer to the inquiry what causes rockets to ascend in the air, we may observe, that it is nearly the same as that which produces a recoil in fire-arms. Thus, when powder is inflamed in the chamber of a musket or cannon, it exerts its power against the breech of the piece, and against the bullet or wadding. But the resistance opposed by the bullet being much less than that opposed by the mafs of the barrel or cannon, the bullet is forced out with great velocity. The cause of the ascent of a rocket is nearly the same. At the moment when the powder begins to inflame, its expansion produces a torrent of elastic fluid, which acts in every direction, that is, against the air which opposes its escape from the cartridge, and against the upper part of the rocket; but the resistance of the air is more considerable than the weight of the rocket; therefore the rocket ascends by the excess of the one of these forces over the other. This, however, would not be the case unless the rockets were pierced to a certain depth.

Brilliant Fire and Chinese Fire.—As iron-filings, when thrown into the fire, enflame and emit a strong light, this gave rise to the idea of rendering the fire of rockets much more brilliant, than when gunpowder, or the substances of which it is composed, are alone employed. But the Chinese have long been in possession of a method of rendering this fire much more brilliant and variegated in its colours. It consists in the use of a very simple ingredient, namely, cast iron reduced to a powder more or less fine: the Chinese give it a name that answers to *iron-sand* in our language. It is prepared from old iron pots pulverized, till the grains are not larger than radish seed. These, however, are passed through sieves of different degrees of fineness; those that pass through the closest sieve, are called sand of the first order;

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order; those which pass through the next sieve in size, and of the second order, and so on. This sand, when it inflames, emits an exceedingly vivid light, forming almost instantaneously luminous flowers and stars of various apparent magnitudes. It should be observed that rockets, into the composition of which iron-filings and iron-sand enter, cannot be long preserved, owing to their readiness in attracting the moisture which the saltpetre gives out. The following tables exhibit the proportions of the different ingredients for rockets of this kind of from 12 to 33 lbs.

For Red Chinese Fire.

Calibres.	Saltetre.	Sulphur.	Charcoal.	Sand of the 1st Order.
Pounds.	Pounds.	Ounces.	Ounces.	oz. dr.
12 to 15	1	3	4	7 0
18 — 21	1	3	5	7 8
24 — 36	1	4	6	8 0

For White Chinese Fire.

Calibres.	Saltetre.	Mealed Gunpowder.	Charcoal.	Sand of the 2d Order.
Pounds.	Pounds.	Ounces.	oz. dr.	oz. dr.
12 to 15	1	12	7 8	11 0
18 — 21	1	11	8 0	11 8
24 — 36	1	11	8 8	12 0

When these materials have been accurately weighed, the saltpetre and charcoal must be three times sifted through a hair sieve, in order to their being well mixed: the iron-sand is then to be moistened with brandy to make the sulphur adhere, and then they are to be thoroughly incorporated.

The upper part of rockets is generally furnished with some composition, which takes fire when it has reached to its greatest height, emits a considerable blaze, or produces a loud report and whizzing noise. Of this kind are fauciflous, maroons, stars, showers of fire, &c. To make room for an artifice of this kind, the rocket is crowned with what is called a pot, which is larger than the rocket. (See fig. 3.) The following is the method of making this pot, and connecting it with the body of the rocket.

The mould for forming the pot, though of one piece, must consist of two cylindric parts of different diameters. That on which the pot is rolled up must be three diameters of the rocket in length, and its diameter must be three fourths that of the rocket; the length of the other ought to be equal to two of these diameters, and its diameter to 2/3 that of the rocket. Having rolled the thick paper, intended for making the pot, twice round the cylinder, a portion of it must be pinched in that part of the cylinder which has the least diameter: this part must be pared in such a manner, as to leave only what is necessary for making the pot fast to the top of the rocket, and the ligature must be covered with paper.

To charge such a pot, attached to a rocket. Having pierced three or four holes in the double paper which covers the vacuity of the rocket, pour over it a small quantity of the composition with which the rocket is filled, and by shaking it, make a part enter these holes; then arrange, in the pot, the composition with which it is to be charged, taking care not to introduce into it a quantity heavier than

the body of the rocket. The whole must be secured by means of a few small balls of paper, to keep every thing in its place, and the pot must be covered with paper cemented to its edges: if a pointed summit be added to it, the rocket is fit for use.

Serpents.—These are small flying rockets, without rods, which, instead of rising in a perpendicular direction, mount obliquely, and descend in a zigzag form, without ascending to a great height. The composition of these is nearly the same as that of rockets, and the construction is as follows. The length, A C, (fig. 4.) of the cartridge is about four inches; it must be rolled on a flick somewhat larger than a goose-quill, and after being choaked at one of its ends, it is filled beyond the middle, as to B, with the composition; then it is to be pinched so as to leave a small aperture. The remainder, B C, must be filled with grained powder, which will occasion a report when it bursts. Lastly, choke the cartridge entirely towards the extremity C; and at the other extremity, A, place a train of moist powder, to which, if fire be applied, it will be communicated to the composition in the part A B, and cause the whole to rise in the air. The serpent, as it falls, will make several turns in a zigzag direction, till the fire is communicated to the grained powder in the part B C; on which the serpent will burst with a loud report before it falls to the ground. The serpent cartridges are generally made of playing cards. These are rolled round a rod of iron or hard wood, and to confine the card a piece of strong paper is cemented over it. Larger serpents may be made by cementing two playing cards together, first moistened with water.

Maroons are small cubical boxes, filled with a composition proper for making them burst. To construct these, cut a piece of palleteboard according to the method taught in geometry to form the cube (see fig. 5.); join these squares at the edges, leaving one only to be cemented, and fill the cavity of the cube with grained powder; then cement strong paper in various directions over the body, and wrap round it two rows of packthread, dipped in strong glue: then make a hole in one of the corners, and introduce into it a match. If the maroons are to be luminous, that is, which are to give out a brilliant light before they burst, they must be covered with a paste, the composition of which will be noticed below under *Stars*, and then rolled in meal powder to serve as a match or communication.

Sauciflous differ from maroons only in form. The cartridges of the latter are round, and must be only four times their exterior diameter in length. They are choaked at one end in the same manner as a rocket, and a pellet of paper is driven into the aperture which has been left, in order to fill it up. They are then charged with corn powder, above which is placed a bail of paper, gently pressed down to prevent the powder from being bruised; the second end of the sauciflous being now choaked, the edges are to be pared on both sides, and the whole is covered with several turns of packthread, dipped in strong glue, and then left to dry.

Stars are small globes which emit a most brilliant light, so that, momentarily, they may be compared to the light of the stars in the heavens. These balls are not larger than a musket-ball, and when put into rockets they must be wrapped up in tow, prepared for the purpose. The composition of these stars is as follows: To a pound of fine mealed gunpowder, add four pounds of saltpetre, and two pounds of sulphur. When these ingredients are thoroughly mixed, take a piece as large as a small nutmeg, and having wrapped

wrapped it in a linen rag, or paper, form it into a ball; then tie it closely round with packthread, and pierce a hole through the middle of it, large enough to receive a piece of prepared tow, which is to serve as a match. This, when lighted, will exhibit a most beautiful appearance; because the fire as it issues from the two ends of the hole in the middle will extend to a great distance, and will make it seem very much larger than it actually is.

There are other compositions for stars; viz. with three ounces of saltpetre, mix one ounce of sulphur, and two drachms of mealed gunpowder; or with eight ounces of mealed powder, mix four ounces of sulphur, and the same quantity of saltpetre. When these materials have been well sifted, and sprinkled over with brandy, in which a small quantity of gum has been dissolved, the star is made in the following manner. Take a rocket mould eight or nine lines in diameter, and introduce into it a nipple, the piercer of which is of an uniform size throughout, and equal in length to the height of the mould. Put into this mould a cartridge, and by means of a pierced rod load it with one of the preceding compositions; when loaded, take it from the mould, without removing the nipple, the piercer of which passes through the composition, and then cut the cartridge quite round into pieces of the thickness of three or four lines. The cartridge being thus cut, draw out the piercer gently, and the pieces which resemble the men employed for playing at drafts, pierced through the middle, will be stars, which must be filed on a match thread, that may be covered with tow. To give more brilliancy to stars of this kind, a cartridge thicker than that already described, and thinner than that of a flying rocket of the same size, may be employed; but before it is cut in pieces, five or six holes must be pierced in the circumference of each piece to be cut. When the cartridge is cut, and the pieces have been filed, cement over the composition small bits of a card, each having a hole in the middle, so that these holes may correspond to the place where the composition is pierced.

Etoiles à Pet are made in the same way nearly as faucifions already described, only that it will not be necessary to cover them with packthread: it will be sufficient if they are pierced at one end, in order that stars may be fastened to them, constructed according to the first method, the composition of which is dry; for if the composition be in the form of paste, there will be no need to tie it. In this case, a little more of the paper must be left hollow at the end of the faucifion which has been pierced for the purpose of introducing the composition, and to place in the vacuity, towards the neck of the faucifion, some grained powder, which will communicate fire to the faucifion when the composition is consumed.

Shower of Fire.—To form this sort of fire-work, mould small paper cartridges on an iron-rod two lines and a half in diameter, and make them two inches and a half in length. They must not be choked, it being sufficient to twist the end of the cartridge, and having put the rod into it to beat it, in order to make it assume its proper form. When the cartridges are filled, which is done by immersing them in the composition, fold down the other end, and then apply a match. This will fill the surrounding air with an undulating fire. The following compositions are given as proper for stars of this kind.

Chinese Fire.—Mealed gunpowder one pound, sulphur two ounces, iron-rod of the first order five ounces.

Ancient Fire.—Mealed gunpowder one pound, charcoal two ounces.

Brilliant Fire.—Mealed gunpowder one pound, iron-filings four ounces. The first of these compositions is thought to be the most beautiful.

Sparks differ from stars only in their size and duration, for they are made smaller than stars, and are consumed sooner. They are thus prepared. Having put into an earthen vessel an ounce of mealed gunpowder, two ounces of pulverized saltpetre, one ounce of liquid saltpetre, and four ounces of camphor reduced to powder, pour over this mixture some gum-water, or brandy in which gum has been dissolved, till the composition becomes of the consistence of thick soup. Then take some lint which has been soaked in brandy, or in vinegar, or even in a solution of saltpetre, and being dried and unravelled, throw into the mixture such a quantity of it as is sufficient to absorb it entirely, taking care to stir it well. This composition may be formed into small balls about the size of a pea, and being dried in the shade, and sprinkled with mealed powder, they will readily catch fire.

Sparks may be made by the following method: Take saw-dust of fir, poplar, &c. and boil it in water in which saltpetre has been dissolved. When the water has boiled some time, it is to be poured off, that the saw-dust may remain in the vessel. When nearly dry, it is to be spread out on a table, and sprinkled with sulphur sifted through a very fine sieve, to which may be added a little mealed powder.

Golden Rain.—Some flying rockets, which, as they fall, make small undulations in the air like frizzled hair, are called by the French writers *fusées chevelues*, and by us bearded rockets; they finish with a kind of shower of fire, which is called golden rain, and they are constructed in the following manner. Fill the barrels of some goose-quills with the composition of flying rockets, and place upon the mouth of each a little moist gunpowder, both to keep in the composition, and to serve as a match. If a flying rocket be then loaded with these quills, they will produce at the end a beautiful shower of fire, which is denominated golden rain.

Conrants, or Rockets that fly along a Rope.—A rocket may be made to run along an extended rope, by affixing to the rocket an empty cartridge, and introducing into it the rope which is to carry it along. Place the head of the rocket towards that side to which you intend it to move; if it be then set fire to, it will run along the rope without stopping till the matter it contains is entirely exhausted. If the rocket is to move in a retrograde direction, first fill one half of it with the composition, and cover it with a small round piece of wood, to serve as a partition between it, and that put into the other half; then make a hole below this partition, so as to correspond with a small canal filled with bruised powder, and terminating at the other end of the rocket. By these means the fire, when it ceases in the first half of the rocket, will be communicated through the hole into the small canal, which will convey it to the other end; and this end being then kindled, the rocket will move backwards, and return to the place from whence it set out.

Two rockets of equal size, bound together by strong packthread, and so arranged that the head of the one shall be opposite to the neck of the other, in order that when the fire has consumed the composition in the one, it may be communicated to that in the other, and oblige both of them to move in a retrograde direction, may likewise be adjusted to the rope by means of a piece of hollow reed. Rockets of this kind are generally employed for setting fire to various other pieces when large fire-works are exhibited; and to render

render them more striking, they are made in the form of different animals, such as serpents, dragons, &c.

To give a rocket a kind of rotatory motion around the rope along which it advances, it will be sufficient to tie to it another rocket, placed in a transversal direction. But the aperture of the latter, instead of being at the bottom, ought to be in the side, near one of the ends. If both rockets be fired at the same time, the latter will make the other revolve around the rope, while it advances along it.

Rockets which burn in the Water.—In these there must be a considerable variation in the construction of the mould, and also in the materials of which they are composed. The mould may be eight or nine inches in length, and an inch in diameter: the former, on which the cartridge is rolled up, may be nine lines in thickness. The composition should consist of three materials mixed together, *viz.* three ounces of mealed powder, one pound of saltpetre, and eight ounces of sulphur. If the rocket is to appear on the water with a beautiful tail, the composition must consist of eight ounces of gunpowder, one pound of saltpetre, eight ounces of powdered and finely sifted sulphur, and two ounces of charcoal. When the composition has been prepared according to these proportions, and the rocket has been filled in the manner above described, apply a caucisson to the end of it, and having covered the rocket with wax, pitch, &c. attach to it a small rod of white willow, about two feet in length, that the rocket may conveniently float. If it be required that these rockets should plunge down, and again rise up, a certain quantity of mealed gunpowder, without any mixture, must be introduced into them, at certain distances.

A rocket which is fired in the water, and, after burning there half the time of its duration, mounts into the air with great velocity, may be thus constructed. Take a *flying* rocket, furnished with a rod, and by means of a little glue attach it to a water-rocket, but only at the middle, A, (*fig. 6.*) in such a manner that the latter shall have its neck uppermost, and the other its neck downward. Adjust to their extremity, B, a small tube, to communicate the fire from the one to the other, and cover both with a coating of pitch, wax, &c. that they may not be damaged by the water. Then attach to the flying rocket, after it has been thus cemented to the aquatic one, a rod, as D, and from F suspend a piece of packthread, to support a musket bullet E, made fast to the rod by means of a needle or piece of iron wire. When these arrangements have been made, set fire to the part C after the rocket is in the water; and when the composition is consumed to B, the fire will be communicated through the small tube to the other rocket; the latter will then rise and leave the other, which will not be able to follow it, on account of the weight adhering to it.

Globes and Fire-Balls are made in different forms, *viz.* spherical, spheroidal, or cylindrical. The spherical are made in the following manner. Construct a hollow wooden globe of any size at pleasure, and very round both within and without, so that its thickness, A C or B D, (*fig. 7.*) may be about the ninth part of its diameter A B, and having an aperture, L M or O N, equal to the thickness A C or B D, that is, to the ninth part of the diameter A B. It is through this aperture that fire is communicated to the globe, when it has been filled with the proper composition, through the lower aperture I K. A petard of metal, loaded with good grained powder, is to be introduced also through the lower aperture, and to be placed horizontally. The aperture I K, which is nearly equal to the thickness, E F or G H, of the cylinder E F G H, is to be closed by means of a wooden tampion dipped in warm pitch; and melt over it such a quantity of lead that its weight may cause the globe to sink

in water, till nothing remain above it but the part G H; which will be the case if the weight of the lead, with that of the globe and the composition, be equal to the weight of an equal volume of water. If the globe be then placed in the water, the lead, by its gravity, will keep the aperture, I K, directly downwards, and the cylinder, E F G H, in a perpendicular direction, to which fire must have been previously applied. The composition with which the globe must be filled, is as follows: to a pound of corned powder, add thirty-two pounds of saltpetre, eight pounds of sulphur, one ounce of scraped ivory, and eight pounds of sawdust previously boiled in a solution of saltpetre, and dried in the open air.

Globes which leap or roll on the Ground.—Having constructed a wooden globe A, (*fig. 8.*) with a cylinder C, similar to the one just described, and having loaded it with the same composition, introduce into it four or even more petards, loaded with good corned powder to their orifices, as is shewn at A B, which must be well stopped with paper or tow. If a globe, prepared in this manner, be fired by means of a match at C, it will leap about as it burns, on a smooth horizontal plane, according as the petards are set on fire. The petards may be affixed to the exterior surface of the globe, as is seen in the figure, which they will cause to roll and leap as they catch fire.

Aerial Globes, called Bombs.—These globes are called aerials, because they are thrown into the air from a mortar. Though they are of wood, and have a suitable thickness, yet they are liable to burst unless the charge be nicely proportioned to their strength. The usual quantity is an ounce of powder for a globe of four pounds weight; two ounces for one of eight, and so on. As the chamber of the mortar may be too large to contain the exact quantity of powder sufficient for the fire-ball, which ought to be placed immediately above the powder, in order that it may be expelled and set on fire at the same time, another mortar may be constructed of wood, or of palte-board with a wooden bottom, which may be put into the large iron mortar, to be loaded with a quantity of powder proportioned to the weight of the globe. This small mortar must be of light wood, or of paper palted together, and rolled up in the form of a cylinder, but the bottom must be of wood. The chamber for the powder must be pierced obliquely, so that the aperture may correspond to the aperture of the metal mortar, then the fire applied to the latter may be communicated to the powder which is at the bottom of the chamber, immediately below the globe.

The globe must be filled with several pieces of reed or cane, or common reed equal in length to the interior height of the globe, and charged with a slow composition, made of three ounces of mealed gunpowder, an ounce of sulphur moistened with a small quantity of petroleum oil, and two ounces of charcoal; and in order that these reeds or canes may catch fire the sooner, and with more facility, they must be charged at the lower ends, which rest on the bottom of the globe, with pulverized gunpowder moistened with petroleum oil or brandy, and then dried. The bottom of the globe ought to be covered with gunpowder, partly mealed and partly corned, which, when set on fire, will communicate the fire to the lower part of the reed. Instead of reeds, the globe may be charged with running rockets, or paper petards, and a quantity of fiery stars or sparks mixed with mealed powder placed above these petards, which must be choaked at unequal heights, that they may produce their effects at different times.

Jets of Fire are a sort of fixed rockets, the effect of which is to throw up into the air jets of fire similar to jets of water.

They serve also to represent cascades, for if a series of such rockets be placed horizontally on the same line, it may be easily seen that the fire which they emit will resemble a sheet of water. When arranged in a circular form, like the radii of a circle, they form what is called a fixed sun. To form jets of this kind, the cartridge for brilliant fires must, in thickness, be equal to a fourth part of the diameter, and for Chinese fire only a sixth part. The cartridge is loaded on a nipple, having a point equal in length to the same diameter, and in thickness to a fourth part of it; but as it generally happens that the mouth of the jet becomes larger than is necessary for the effect of the fire, the cartridge must be filled equal to a fourth part of the diameter with clay, which must be rammed down. This will make the jet ascend much higher. When the charge is completed with the proper composition, the cartridge must be closed with a stopper of wood, above which it must be choked. Jets intended for representing sheets of fire ought not to be choked. They must be placed in a horizontal position, or inclined a little downwards. The following are the principal compositions for jets of fire.

1. *For Jets of half an Inch or less in Diameter.—Chinese fire:* Saltpetre and mealed powder 1lb. each; sulphur 8 ounces; charcoal 2 ounces.—*White fire:* Saltpetre 1lb.; mealed powder 8 ounces; sulphur 3 ounces; charcoal 2 ounces; iron-sand of the first order 8 ounces.

2. *For Jets of an Inch or less in Diameter.—Brilliant fire:* Mealed powder 1lb., iron-filings 5 ounces.—*White fire:* Saltpetre and mealed powder 1lb. each; sulphur 8 ounces; charcoal 2 ounces.—*Chinese fire:* Saltpetre 16 ounces; sulphur 5 ounces; charcoal 5 ounces; iron-sand of the third order 12 ounces.

3. *For Jets of 15 or 18 Lines in Diameter.—Chinese fire:* Saltpetre 16 ounces; sulphur 7 ounces; charcoal 5 ounces; of the several different kinds of iron-sand mixed 12 ounces.

Fires of different Colours.—For *white fire* the gunpowder must be mixed with iron or rather steel-filings: for *red fire*, iron-sand of the first order must be employed in the same way. Camphor mixed with the usual composition is said to make the flame appear of a *pale white* colour. Rasplings of ivory give a clear flame of a silver colour.

Paste for representing Animals, &c. in Fire.—Take sulphur reduced to a very fine powder, and having formed it into a paste with starch, cover it with the figure of the thing to be represented, having first coated it with clay to prevent it from being burnt. After the figure is covered with the paste, it must be sprinkled, while moist, with gunpowder; and when the whole is perfectly dry, arrange about it several small matches, that the fire may be speedily communicated to it on all sides. In this way all sorts of garlands, festoons, and other ornaments, may be imitated by fire of different colours.

Suns, fixed and moveable.—For fixed suns, let a round piece of wood be cut, into the circumference of which are to be screwed twelve or fifteen pieces in the form of radii, to which are to be attached jets of fire, of the composition described above; so that they may appear as radii tending to the same centre, the mouth of the jet being towards the circumference. Apply a match in such a manner that the fire communicated at the centre, may be conveyed at the same time to the mouth of each of the jets, by which means, each throwing out its fire, there will be produced the appearance of a radiating sun, that is, supposing the wheel is placed in a position perpendicular to the horizon. The rockets or jets may be so arranged as to cross each other in an angular manner, in which case, instead of a sun, you will have a star, or a cross. Some of these suns are made also

with several rows of jets, which are called glories. For revolving suns, provide a wooden wheel, and attach to the circumference fire-jets placed in the direction of the circumference: they must not be choked at the bottom, and ought to be arranged in such a manner, that the mouth of the one shall be near the bottom of the other, so that when the fire of the one is ended, it may immediately proceed to another. When the fire is applied to one of these jets, the recoil of the rocket will make the wheel turn round, unless it be too large and ponderous. For this reason, when these suns are of a considerable size, that is, when they consist of perhaps twenty rockets, fire must be communicated at the same time to the first, the sixth, eleventh, and sixteenth, from which it will proceed to the second, the seventh, the twelfth, the seventeenth, and so on. These four rockets will make the wheel turn round with great rapidity. If two similar suns be placed one behind the other, and are made to turn in a contrary direction, they will produce a fine effect of cross-fire.

Making, loading, and firing Pots des Brins.—These are made of paste-board, and must be rolled pretty thick; usually made three or four inches in diameter, and four diameters long, and pinched with a neck at one end, like common casks. A number of these are placed on a plank thus: having fixed on a plank two rows of wooden pegs, cut in the bottom of the plank a groove the whole length under each row of pegs; then, through the centre of each peg, bore a hole down to the groove at bottom, and on every peg fix and glue a pot, whose mouth must fit tight on the peg; through all the holes run a quick-match, one end of which must go into the pot, and the other into the groove, which must have a match laid in it from end to end, and covered with paper, so that, when lighted at one end, it may discharge the whole almost instantaneously: in all the pots put about one ounce of meal and corn powder; then in some put stars, and others rains, snakes, serpents, crackers, &c.: when they are all loaded, paste paper over their mouths. Two or three hundred of these pots being fired together, make a very pretty show, by affording so great a variety of fires. Fig. 9. is a range of pots des brins, with the leader A, by which they are fired.

Caduceus Rockets, in rising, form two spiral lines, or double worm, by reason of their being placed obliquely, one opposite the other; and their counterpoise is in their centre, which causes them to rise in a vertical direction. Rockets for this purpose must have their ends choked close, without either head or bounce, for a weight at top would be a great obstruction to their mounting; though they have been known sometimes to be bounced, but then they did not rise so high as those that were not; nor do any caduceus rockets ascend so high as single, because of their serpentine motion, and likewise the resistance of air, which is much greater than two rockets of the same size would meet with, if fired singly.

By fig. 10. we see the method of fixing these rockets: the sticks for this purpose must have all their sides equal, which sides should be equal to the breadth of a stick proper for a sky-rocket of the same weight as those we intend to use, and to taper downwards as usual, long enough to balance them, one length of a rocket, from the cross stick, which must be placed from the large stick, six diameters of one of the rockets, and its length seven diameters; so that each rocket, when tied on, may form with the large stick an angle of sixty degrees. In tying on the rockets, place their heads on the opposite sides of the cross stick, and their ends on the opposite sides of the long stick; then carry a leader from the mouth of one into that of the other. When these rockets are to be fired, suspend them between two hooks or nails,

nails, then burn the leader through the middle, and both will take fire at the same time. Rockets of one pound are a good size for this use.

Illuminated Spiral Wheel.—First have a circular horizontal wheel, made two feet in diameter, with a hole quite through the nave; then take three thin pieces of deal, three feet long each, and three quarters of an inch broad each: one end of each of these pieces nail to the fell of the wheel, at an equal distance from one another, and the other end nail to a block with a hole in its bottom, which must be perpendicular with that in the block of the wheel, but not so large. The wheel being thus made, take a hoop planed down very thin and flat; then nail one end of it to the fell of the wheel, and wind it round the three flicks in a spiral line, from the wheel to the block at top: on the top of this block fix a case of Chinese fire; on the wheel you may place any number of cases, which must incline downwards, and burn two at a time. If the wheel should consist of ten cases, you may let the illuminations and Chinese fire begin with the second cases. The spindle for this wheel must be a little longer than the cone, and made very smooth at top, on which the upper block is to turn, and the whole weight of the wheel to rest. See *fig. 11*.

Fruitioni Wheels.—First take a nave, made nine inches long, and three in diameter: near the bottom of this nave fix eight spokes, with a hole in the end of each, large enough to receive a two or four-ounce case: each of these spokes may be fourteen inches long from the block. Near the top of this block fix eight more of the same spokes, exactly over the others, but not so long by two inches. As this wheel is to run horizontally, all the cases in the spokes at top must play obliquely upwards, and all of them in the spokes at bottom obliquely downwards. This being done, take a small horizontal wheel, made with eight spokes, each five inches long from the block; on the top of this wheel place a case of brilliant fire: all the cases on this wheel must play in an oblique direction downwards, and burn two at a time, and those on the large wheel four at a time; that is, two of those in the top set of spokes, and two of them in the bottom set of spokes. The four first cases on the large wheel, and the two first on the small, must be fired at the same time, and the brilliant fire at top, at the beginning of the last cases. The cases of the wheels may be filled with a grey charge. When these wheels are completed, you must have a strong iron spindle, made four feet six inches long, and fixed perpendicular on the top of a stand: on this put the large wheel, whose nave must have a hole quite through, from the bottom to the top. This hole must be large enough to turn easy round the bottom of the spindle, at which place there must be a shoulder, to keep the wheel from touching the stand: at the top of the spindle put the small wheel, and join it to a large one with a leader, in order to fire them both together.

Illuminated Globes, with horizontal Wheels.—The hoops for these globes may be made of wood, tin, or iron wire, about two feet in diameter. For a single globe take two hoops, and tie them together, one within the other, at right angles; then have a horizontal wheel made, whose diameter must be a little wider than the globe, and its nave six inches long, on the top of which the globe is fixed, so as to stand three or four inches from the wheel: on this wheel you may put any number of cases, filled with what charge you like; but let two of them burn at a time: they may be placed horizontally, or to incline downwards, just as you choose. Now, when the wheel is clothed, fix on the hoops as many illuminations as will stand within two inches and a half of each other: these you fasten on the hoops with small iron binding

wire; and when they are all on, put on your pipes of communication, which must be so managed as to light them all with the second or third case on the wheel. The spindle on which the globe is to run must go through the block of the wheel, up to the inside of the top of the globe, where must be fixed a bit of brass or iron, with a hole in it to receive the point of the spindle, on which the whole weight of the wheel is to bear, as in *fig. 12*, which represents a globe on its spindle. By this method may be made a crown, which is done by having the hoops bent in the form of a crown. Sometimes globes and crowns are ordered so as to stand still, and the wheel only to turn round; but when you would have the globe or crown to stand still, and the wheel to run by itself, the block of the wheel must not be so long, nor the spindle any longer, than to just raise the globe a little above the wheel, and the wheel-cases and illumination must begin together.

Dodecahedron, so called because it nearly represents a twelve-sided figure, and is made thus. First take a ball, turned out of some hard wood, fourteen inches in diameter: when done, divide its surface into fourteen equal parts, from which bore holes an inch and a half in diameter perpendicular to the centre, so that they may all meet in the middle: then let there be turned in the inside of each hole a female screw; and to all the holes, but one, must be made a round spoke, five feet long, with four inches of the screw at one end, to fit the holes; then in the screw end of all the spokes bore a hole, five inches up, which must be bored slanting, so as to come out at one side, a little above the screw; from which cut a small groove along the spoke, within six inches of the other end, where you make another hole through to the other side of the spoke: in this end fix a spindle, on which put a small wheel, of three or four sides, each side six or seven inches long: these sides must have grooves cut in them, large enough to receive a two or four-ounce case: when these wheels are clothed, put them on the spindles, and at the end of each spindle put a nut, to keep the wheel from falling off: the wheels being thus fixed, carry a pipe from the mouth of the first case on each wheel, through the hole in the side of the spoke, and from thence along the groove, and through the other hole, so as to hang out at the screw end about an inch. The spokes being all prepared in this manner, you must have a post, on which you intend to fire the work, with an iron screw in the top of it, to fit one of the holes in the ball: on this screw fix the ball; then in the top hole of the ball put a little meal powder, and some loose quick-match; then screw in all the spokes, and in one side of the ball bore a hole, in which put a leader, and secure it at the end; and your work will be ready to be fired. By this leader the powder and match in the centre are fired, which will light the match at the ends of the spokes all at once, whereby all the wheels will be lighted at once. There may be an addition to this piece, by fixing a small globe on each wheel, or one on the top wheel only. A grey charge will be proper for the wheel-cases.

Tee-tree of brilliant Fire, is represented by *fig. 13*, as it appears when burning. First, let A be an upright piece of wood, four feet long, two inches broad, and one thick: at top of this piece, on the flat side, fix a hoop, fourteen inches in diameter; and round its edge and front place illuminations, and in the centre a five-pointed star; then at E, which is one foot and a half from the edge of the hoop, place two cases of brilliant fire, one on each side: these cases should be one foot long each: below these fix two more cases of the same size, and at such a distance, that their mouths may almost meet them at top: then, close to the ends of these cases, fix two more of the same cases; they must stand parallel

parallel to them at E. The cakes being thus fixed, clothe them with leaders, so that they, with the illuminations and star at top, may all take fire together.

Illuminated Yew-tree.—First have a tree made of wood, such as is shewn by *fig. 14.* The middle piece, or stem, on which the branches are fixed, must be eight feet six inches high: at the bottom of this piece draw a line, at right angles, two feet six inches long at each side; then from L, which is one foot six inches from the bottom, draw a line on each side to C and D; these lines will give the length of the two first branches. Then put on the two top branches parallel to them at bottom: let the length of each of these branches be one foot from the stem: from the ends of these two branches draw a line to C and D; then fix on five more branches at an equal distance from each other, and their length will be determined by the lines A C and E D. When the branches are fixed, place illuminating port-fires on the top of each, as many as you choose: behind the top of the stem fasten a gerbe, or white fountain, which must be fired at the beginning of the illuminations on the tree.

Moon and Seven Stars.—Let *fig. 15.* be a smooth circular board, six feet diameter; out of the middle of it cut a circular piece twelve or fourteen inches diameter, and over the vacancy put white Persian silk, on which paint a moon's face; then let I, I, I, &c. be stars each four or five inches in diameter, cut out with five points, and covered with oiled silk: on the front of the large circular board draw a seven-pointed star, as large as the circle will allow; then on the lines which form this star bore holes, wherein fix pointed stars. When this piece is to be fired, it must be fixed upon the front of a post, on a spindle, with a wheel of brilliant fire behind the face of the moon; so that while the wheel burns, the moon and stars will appear transparent, and when the wheel has burnt out, they will disappear, and the large star in front, which is formed of stars, will begin, being lighted by a pipe of communication from the last case of the vertical wheel, behind the moon: this pipe must be managed in the same manner as those in regulated pieces.

Pin Wheels.—First roll some paper pipes, about fourteen inches long each; these pipes must not be made thick of paper, two or three rounds of elephant paper being sufficient. When your pipes are thoroughly dried, you must have made a tin tube, twelve inches long, to fit easy into the pipes: at one end of this tube fix a small conical cup, which done is called a funnel; then bend one end of one of the pipes, and put the funnel in at the other, as far as it will reach, and fill the cup with composition; then draw out the funnel by a little at a time, shaking it up and down, and it will fill the pipe as it comes out. Having filled some pipes, and made some small blocks, about an inch in diameter, and half an inch thick; round one of these blocks wind and paste a pipe, and to the end of this pipe join another; which must be done by twisting the end of one pipe to a point, and putting it into the end of the other, with a little paste; in this manner join four or five pipes, winding them one upon the other, so as to form a spiral line. Having wound on your pipes, paste two slips of paper across them, to hold them together: besides these slips of paper the pipes must be pasted together.

There is another method of making these wheels, called the French, which is, by winding on the pipe without paste, and sticking them together with sealing wax, at every half-turn; so that, when they are fired, the end will fall loose every time the fire passes the wax; by which means the circle of fire will be considerably increased. The formers for these pipes are made from one-half to four-sixteenths of an inch diameter, and the composition for them as follows;

meal powder eight ounces, saltpetre two ounces, and sulphur one: among these ingredients may be mixed a little steel-slings, or the dust of cast-iron: this composition should be very dry, and not made too fine, or it will stick in the funnel. These wheels may be fired on a large pin, and held in the hand with safety.

Placing Fire-works to be exhibited, with the *Order of Firing.* Nothing adds more to the appearance of fire-works, than the placing them properly; though the manner of placing them chiefly depends on the judgment of the maker. We shall give such rules here, as have been generally observed; for example, whether your works are to be fired on a building, or on stands. If they are a double set, place one wheel of a fort on each side of the building; and next to each of them, towards the centre, place a fixed piece, then wheels, and so on, leaving a sufficient distance between them, for the fire to play from one without burning the other. Having fixed some of your works thus in front, place the rest behind them, in the centre of their intervals: the largest piece, which is generally a regulated or transparent piece, must be placed in the centre of the building, and behind it a fun, which must always stand above all the other works: a little before the building, or stands, place your large gerbes; and at the back of the works, fix your maroon batteries, pots des aigrettes, pots des brins, pots des saucissons, air-balloons, and flights of rockets: the rocket-stands may be fixed behind, or any where else, so as not to be in the way of the works.

Single collections are fired on stands, which stands are made in the same manner as theodolite stands, only the top part must be long or short occasionally: these stands may be fixed up very soon without much trouble. Having given sufficient instructions for placing of fire-works, we shall proceed with the manner of firing them.

Order of Firing.

1. Two signal
2. Six sky
3. Two honorary
4. Four caduceus
5. } Two { vertical } wheels illuminated.
6. } { spiral }
7. } { transparent stars.
8. A line rocket of five changes.
9. Four tourbillons.
10. } { horizontal wheels.
11. } { air-balloons illuminated.
12. } Two { Chinese fountains.
13. } { regulating pieces of four mutations each.
14. } { pots des aigrettes.
15. Three large gerbes.
16. A flight of rockets.
17. } Two { balloon wheels.
18. } { cascades of brilliant fire.
19. Twelve sky-rockets.
20. } Two { illuminated yew-trees.
21. } { air-balloons of serpents, and two compound.
22. Four tourbillons.
23. } Two { Fruiloni wheels.
24. } { illuminated globes with horizontal wheels.
25. One pot des saucissons.
26. Two plural wheels.
27. Marron battery.
28. Two chandeliers illuminated.
29. Range of pots des brins.
30. Twelve sky-rockets.
31. Two yew-trees of fire.

32. Nest of serpents.
33. Two double cones illuminated.
34. Regulating piece of seven mutations, *viz.*
 1. Vertical wheel illuminated.
 2. Golden glory.
 3. Octagon vertical wheel.
 4. Porcupine's quills.
 5. Crofs fires.
 6. Star piece with brilliant rays.
 7. Six vertical wheels.

35. Brilliant sun.

36. Large flight of rockets.

When water-works are to be exhibited, divide them into several sets, and fire one set after every fifth or sixth change of land and air-works. Observe this rule in firing a double set of works; always to begin with sky-rockets, then two moveable pieces, then two fixed pieces, and so on; ending with a large flight of rockets, or a maroon battery: if a single collection, fire a fixed piece after every wheel or two, and now and then some air and water-works. Jones's Fire-works, 8vo. 1776.

PYROTECHNICAL SPUNGE. See SPUNGE.

PYROTICS, Πυρωτικά, formed from πυρ, *fire*, in *Medicine*, caustics, or remedies, either actually or potentially hot; and which, accordingly, will burn the flesh, and raise an eschar.

PYROUET. See PIROUETTE.

PYROXENE, in *Mineralogy*. See AUGITE and LAVA.

According to Haüy, the mineral called augite by Werner is the black or greenish-black variety of pyroxene found in volcanic countries and in basalt. The primitive form of the crystals of pyroxene is an oblique rhomboidal prism.

The greyish-green transparent pyroxene, with the forms of the crystals distinctly marked, from the department of the Po, is the alalite of Bouvoisin. *Journal des Mines*, N° 115.

The greyish-green, or whitish-grey variety, the primitive crystals of which are indistinct, from the same department, were called by Bouvoisin massite. Both these varieties have been called by some mineralogists diopside.

The greyish-green and obscure green perioctahedral variety of pyroxene, is the fahsite of Werner, called also malacolithe by Haüy. The mineral called coccolite, discovered by Dandrada at the iron mines of Sudermannland and Nerika, in Sweden, and Arendahl in Norway, is also brought under the species pyroxene by Haüy. *Tableau Comparatif*.

By reducing many varieties of minerals under one species, Haüy may be considered as having rendered an additional service to mineralogy, already too much loaded with pedantic or unmeaning terms; but the term pyroxene itself may be justly objected to, as being founded not on any distinct character, but on the hypothetical assumption that these crystals are foreign to the igneous products in which they are imbedded, an assumption for which there does not appear sufficient proof. The constituent parts of pyroxene, its specific gravity and hardness, so nearly agree with those of basaltic hornblende, that these substances ought perhaps to be classed as varieties of the same species, without regarding the small difference of their crystalline forms. See HORNLENDE.

PYROXENE *en Roche*, or *Rock Pyroxene*. In the *Journal des Mines*, Nov. 1812, a description is given of entire rocks composed of pyroxene, discovered by J. Charpentier in the Pyrenées. The substance is homogeneous, of a texture commonly granularly lamellar, which in some pieces becomes flaty. Its most common colour is green of various shades, from an olive green to an emerald green, sometimes cloudy but often clear. From a greenish-grey it passes to a reddish-brown and ochre yellow. It is amorphous. The

lustre is splendid. Its fracture is lamellar, and has a two-fold cleavage equally perfect, crossing at an angle of about 92°. In other directions the fracture is either imperfectly lamellar or conchoidal. It scratches glass, and gives some sparks with steel. It melts with great difficulty by the blowpipe, but with borax it easily forms a green glass. M. Vogel has analysed this mineral, and discovered chrome in the green specimen. From the detailed description of this rock, it appears nearly allied to schistose, spar, and serpentine. It is frequently intimately combined with talc, in which state it is not easy to distinguish it from serpentine. Rock pyroxene is found in beds in the primitive limestone, that forms vast mountains superincumbent on granite, extending from the valley of Viedessos, in the department of Arriège, to St. Beat, in the valley of Garonne. The masses of rock pyroxene are of extraordinary size, extending in length 5000 toises. Its thickness is difficult to determine, but is supposed to exceed 300 toises. Charpentier is disposed to class rock pyroxene as an intermediate rock between hornblende and serpentine, and subordinate to primitive limestone. It neither contains foreign beds nor mineral veins, and is less liable to decomposition when pure, than almost any other rock. When intermixed with talc it decomposes rapidly.

PYRRHA, in *Ancient Geography*, a town of the isle of Lesbos, between the promontory Sigrium and the town of Erebus, according to Ptolemy. The town took its name from a strait between Asia Minor and the isle of Lesbos, and gave it to a forest in the same isle.—Also, a town of Macedonia, in Magnesia. Pliny.—Also, a town of Asia Minor, in Lycia. Pliny.—Also, a town of Asia Minor, in Ionia, situated at the entrance of the northern part of the Latmic gulf, E.N.E. of the town of Miletus, and S.S.E. of that of Myus. Strabo places it at 100 stadia from Heraclea—Also, a promontory of Thessaly, upon the coast of the Phthiotide. Strabo says, that before this promontory were two isles; one called Pyrrha, and the other Deucalion.—Also, a town of Greece, in the Phocide. Pliny.—Also, a town situated in the vicinity of the Palus-Mæotis; submerged according to the relation of Pliny.—Also, a town of Asia Minor, in Caria.

PYRRHICHA, Πυρρική, in *Antiquity*, a kind of exercise on horseback; or a feigned combat, for the exercise of the cavalry.

It was thus called from its inventor Pyrrhicus, or Pyrrhus, in Cydonia, who first taught the Cretans to march in measure and cadence to battle, and to observe the pace of the Pyrrhic foot. Others derive the name from Pyrrhus, son of Achilles, who instituted this exercise at the obsequies of his father. Aristotle says, that it was Achilles himself who invented it.

The Romans also called it *ludus Trojanus*, the Trojan game; and Aulus Gellius *decurfus*. It is doubtless this exercise, that we see represented on medals, by two cavaliers in front, running with lances, and the word *decurfusio* in the exergum.

PYRRHICHIUS, Πυρρικός, in the Greek and Latin *Poetry*, a foot consisting of two syllables, both short; as *deus*.

Among the ancients this foot is also called *periambus*; by others *hegemonia*.

PYRRHICUS, in *Ancient Geography*, a town of Laconia, upon the stream of Scyrax, S. of Hypsus. Here were two temples, one of Diana Astratæa, and another of the Amazonian Apollo. The statues of these deities were of wood, and it is supposed they were placed here by the Amazons themselves.

PYRRHO. See PYRRHONIANS.

PYRRHO.

PYRRHOCORAX, in *Ornithology*, a species of *Corvus* (which see), the Alpine crow of Latham, and the Choucas des Alpes of Buffon.—Also, the Monedula, Coracias of Aldrovand, &c., Cornish chough, red-legged crow of Pennant and Latham, and *CORVUS Graculus*, which see.

PYRRHONIANS, **PYRRHONEANS**, or *Pyrrhonists*, a sect of ancient philosophers, so called from their founder Pyrrho, a Greek philosopher, born at Elea, in Peloponnesus, who in early life studied painting, but aspiring to philosophical pursuits he became a disciple of Anaxarchus, and accompanied him as far as India. In this journey he followed Alexander the Great; and hence we may know in what time he flourished. In India he conversed with the Brachmans and Gymnosophists, imbibing from their doctrine whatever might seem favourable to his natural disposition towards doubting; a disposition which was cherished by his master, who had formerly been a disciple of a sceptical philosopher, Metrodorus of Chios. As he was involved in fresh uncertainty by every advance he made in the study of philosophy, he left the school of the Dogmatists, who professed to be possessed of certain knowledge, and established a new school, in which he taught, that every object of human inquiry is involved in uncertainty, so that it is impossible ever to arrive at the knowledge of truth.

The distinguishing character of this philosopher was, that he professed to doubt of every thing, maintaining that men only judge of truth and falsehood from appearances, which deceive. On this principle he kept himself in continual suspension of mind, never determining on any thing; to avoid the inconveniences of error and false judgments.

He found in all things (says Bayle) reasons to affirm and to deny; and therefore he suspended his assent after he had well examined the arguments *pro* and *con*, and reduced all his conclusions to a *non liquet*, let the matter be farther enquired into. Hence it is (says he) that he sought truth as long as he lived, but he so contrived the matter, as never to grant that he had found it. Though he is not the inventor of that method of philosophizing, yet it goes by his name. The art of disputing about every thing, without doing any thing else but suspending one's judgment, is called Pyrrhonism, or Scepticism.

Some have said, that this philosopher acted upon his own principles, and carried his scepticism to an extreme so ridiculous, that his friends were obliged to accompany him wherever he went, that he might not be run over by carriages, or fall down precipices. These reports, however, are inconsistent with the respect that is paid to him by ancient writers, and with the general history of his life, and are charged, as calumnies, upon the Dogmatists, whom he opposed. A great part of his life was spent in solitude; and he always preserved a settled composure of countenance, undisturbed by fear, or joy, or grief. He endured bodily pain with great fortitude; and in the midst of dangers he manifested no signs of apprehension. As a disputant, he was celebrated for the subtlety of his arguments, and the perspicuity of his language. So highly was Pyrrho esteemed by his countrymen, that they honoured him with the office of chief priest, and from respect to him, passed a decree by which all philosophers were indulged with an exemption from public taxes. Of the poets, and particularly of Homer, he was a great admirer; and frequently repeated passages from his poems. He flourished about the 110th olympiad, and died about the 90th year of his age, probably in the 123d olympiad, B.C. 288. After his death, the Athenians honoured his memory with a statue; and a monument, as Laertius informs us, was erected to him in his own country. His scepticism may in a great measure

be ascribed to his early acquaintance with the system of Democritus. Having learned from this philosopher to deny the real existence of all qualities in bodies, except those that are essential to primary atoms, and to refer every thing else to the perceptions of the mind produced by external objects, that is, to appearance and opinion, he concluded, that all knowledge depended upon the fallacious report of the senses, and consequently, that there can be no such thing as certainty. In this notion he was encouraged by the general spirit of the Eleatic school, in which he was educated, which was unfavourable to science. But his scepticism was more confirmed by the subtleties of the Dialectic school, in which he was instructed by Bryson, the son of Stilpo. Regarding mental tranquillity as the great end of all philosophy, and observing that nothing contributed so much to disturb it, as the dissensions which agitated the schools of the Dogmatists, and also inferring from their endless disputes the uncertainty of the questions which they debated, he had recourse to the doctrine of universal uncertainty; and thus it happened in his case, as in that of many others, that controversy became the parent of scepticism.

Pyrrho had several disciples, but none who merit particular notice except Timon, the Phliasian, who lived to the age of 90 years, and flourished in the time of Ptolemy Philadelphus. The public succession of professors in the Pyrrhonic school terminated with Timon, and in Cicero's time this school was extinct. The disciples of Timon chose to screen their scepticism under the authority of the Academy; and after some interval, the school itself was revived by Ptolemæus, a Cyrenian, and continued at Alexandria by Cæcilius, a contemporary with Cicero: the latter wrote a treatise "On the Principles of the Pyrrhonian Philosophy," the heads of which are preserved by Photius. From his time it was transmitted, through a series of preceptors little known, to Sextus Empiricus, who has given a summary of the sceptical doctrine; for an account of which, see **SCEPTICS**. As for Pyrrho and his followers, they rather endeavoured to demolish every other philosophical structure, than to erect one of their own. They asserted nothing; but proposed positions merely in the way of enunciation, without attempting to determine on which side, in any disputed question, the truth lay, or even presuming to assert, that one proposition was more probable than another.

Those now distinguished by the name of Pyrrhonians, or Sceptics, are persons who, from the great number of things that are dark and obscure, and from the aversion they bear to popular credulity, maintain, that there is nothing certain in the world.

The truth is, Pyrrhonism has some foundation in nature: we do not judge of things from their real essences, but from their relations to ourselves. Most of our ideas we receive by means of our senses; but our senses are not given us to judge of the essences, but of the relations of things to themselves; *i. e.* how they may affect us so as to do us good or harm.

Thus, *e. gr.* our eyes do not give us the real magnitudes of objects, but their relative ones only.

The Academics differed from the Pyrrhonians, in that they owned there were some things more like or more near akin to truth than others, which the Pyrrhonians peremptorily denied. On account of the similarity of the opinions of this sect and those of the Platonic school in the Middle and New Academy, it happened, that many of the real followers of Pyrrho chose to screen themselves from the reproach of universal scepticism, by calling themselves *Academics* (which see); and hence the appellation of **Pyrrhonists**.

rhonists fell into disuse, whilst the doctrine of Pyrrho had many advocates. For the difference between them, see SCEPTICS.

Le Clerc observes, that the Pyrrhonians, in affirming that there is nothing certain, were the most assuming and decisive of all philosophers; since they must first have examined all things, to be able to determine precisely that all things are uncertain.

It may be added, that the very principle of the Pyrrhonians destroys itself; for if there be nothing certain, then must that dogma itself be precarious; and if no one thing be more probable, or liker to truth than another, why shall the principle of the Pyrrhonians be believed preferably to the opposite one? since itself is come at in the same way as our other knowledge. Brucker's Hist. of Philos. by Enfield, vol. i.

PYRRHUM, in *Ancient Geography*, a town of Pannonia, on the route from Pætovia to Siscia, between Aquaviva and Dautona, according to the Itin. of Antonine.

PYRRHUS, in *Biography*, king of Epirus, one of the most distinguished warriors of the period in which he flourished, supposed to be descended from Pyrrhus, the son of Achilles, was the son of Æacides, who was expelled the kingdom by a revolt of his subjects. When Pyrrhus was only twelve years of age, he was placed on the throne of his ancestors by Glaucias, king of Illyria, who had protected him in his infancy. He reigned in peace till he was about seventeen years of age, when, being absent from his kingdom, his subjects seized his treasures, and conferred the crown upon his great uncle, Neoptolemus. Pyrrhus being possessed of no force to enable him to recover his authority, repaired to Demetrius Poliorettes, the son of Antigonus, who had married his sister, and under that eminent commander he learned the art of war, in company with many officers and soldiers of Alexander the Great. At the battle of Ipsus, in the year B.C. 301, he greatly distinguished himself, and after its loss by Demetrius, he secured for him the Greek cities, with the care of which he had been entrusted. When a treaty of peace was concluded between Demetrius and Ptolemy Lagus, king of Egypt, Pyrrhus consented to be one of the hostages sent into that country for the performance of the conditions. In the Egyptian court he excited general admiration by his amiable and correct behaviour, and his dexterity in martial exercises; and he obtained from the king his daughter Antigone in marriage. The next step was to restore him to his throne, which was effected by an armament supplied by Ptolemy, with the aid of which he defeated Neoptolemus. That prince, however, being supported by his allies, Pyrrhus consented to allot him a share of his dominions; but such a partnership was not likely to be durable, and Neoptolemus, it was said, attempted to poison Pyrrhus, which gave the latter a pretence to order his death. He being settled on the throne of Epirus, began to execute those schemes of ambition, in which the remainder of his life was spent. A civil war raging between the two sons of Cassander, in Macedonia, one of them, Alexander, applied to Pyrrhus for assistance. He gladly took occasion of interfering in the affairs of that kingdom, and being put in possession of all its maritime towns, proceeded to conquer the rest for Alexander. A peace was made, by which Macedonia was divided between the two brothers, and Pyrrhus seems to have withdrawn his troops to his own country. Shortly after, Demetrius made himself master of the kingdom, and notwithstanding their former friendship, hostilities ensued between him and Pyrrhus, who harassed him by incursions into Thessaly. They mutually

invaded each other's kingdoms; and in one instance, Pyrrhus gained so complete a victory over the principal general of his antagonist, and displayed so much courage, that he struck with admiration the Macedonians whom he had defeated, who deserted their own king, and chose Pyrrhus for their sovereign. This occurred in the year B.C. 287. He held this crown, however, a short time; for Lyfimachus, in the following year, entering the country with a powerful army, and remonstrating against the injustice of conferring the kingdom on a foreigner, in prejudice to him, a native and commander under Alexander the Great, the allegiance of the Macedonians seemed to Pyrrhus so little to be relied on, that he withdrew from the contest, and returned to Epirus. The Romans, engaged in a war with the Tarentines, looked for assistance to Pyrrhus. This prince eagerly listened to the proposal, and communicated his determination to his prime-minister Cyneas, who, being more prudent than his master, endeavoured to dissuade him from it. The enterprize was, however, resolved on, and Cyneas was sent with a body of troops to Tarentum, where he subverted the Roman influence, which was beginning to prevail, and obtained the command of the citadel for an Epirot officer. Pyrrhus followed, and having left his son Ptolemy regent of Epirus, landed in Italy, in the year 280 B.C., bringing with him an army of about 25,000 men, of whom 7000 were Macedonians, the veteran soldiers of Alexander the Great. He also brought a number of war-elephants, which was the first time that these animals were seen, in that character, in Italy. He was greatly endangered in his passage by a storm, which dispersed his fleet, and destroyed some of the ships that kept company with him. On his arrival at Tarentum, he began to correct the licentious manners of the inhabitants, and enure them to military discipline. At length he marched out to meet the Roman consul Valerius Lævinus, who was waiting for him on the bank of the Siris, in Lucania. The engagement was extremely obstinate, and Pyrrhus, who exerted himself in a manner worthy of his high reputation, was in great personal danger. Victory, however, decided in his favour, and he took possession of the enemy's camp. In interring the dead he made no distinction between his own men and the soldiers of his antagonist, but bestowed due encomia upon the bravery of his fallen foes. He followed up his victory, and had proceeded so far as to obtain a distant view of Rome. The advance of the other consul obliged him to retire, and he finished his campaign by returning to Tarentum. Sensible that he had engaged in no easy task, he was delighted to receive an embassy from the Romans, which he imagined was to solicit peace, but it was only to negotiate an exchange of prisoners. In this embassy was included the virtuous Fabricius, whom he in vain attempted to gain to his interest by large offers. He then attempted to make a treaty, and sent his minister, Cyneas, to Rome for that purpose, but was unsuccessful.

In the next campaign, two consuls with their armies marched against the king of Epirus; the battle was extremely bloody, and the victory so indecisive, that both parties claimed it: one of the consuls was killed, and Pyrrhus was severely wounded; and such was the loss of men, that to one who congratulated him as having been the conqueror, he frankly replied, "such another victory will ruin me." Both the consuls of the next year, one of whom was Fabricius, were employed to oppose Pyrrhus, who had received fresh reinforcements from Epirus. They advanced to the Tarentine territory, where, while they were seeking an opportunity to engage, an offer was made them by the physician of Pyrrhus, to take him off by poison. Detest-

ing the treachery, they informed the king of his danger, which so affected him, that he immediately liberated all his Roman prisoners without a ransom. He now sent Cyneas to Rome to renew the attempt at negotiation, but was again unsuccessful. During the state of perplexity which a refusal had thrown him into, he was invited by the Syracusans and others to lend his aid against the Carthaginians, who had established themselves in Sicily. He accordingly seized the pretext for changing the field of action, and embarked the whole army for that island, leaving only a strong garrison in Tarentum. On his arrival he was received with general acclamations, and all the public force of Syracuse was put into his hands. He was soon to completely successful, that the Carthaginians sent deputies to Pyrrhus to treat for peace, but he refused to listen to any other condition, than that of their entirely evacuating the island. In confidence of success, he caused a son to be proclaimed king of Sicily, and then made preparations to cross over into Africa, and carry the war into the Carthaginian territories. These projects were not agreeable to the Sicilians, who became alienated from him, and whom he treated not as friends, but as a conquered people. After this he quitted Sicily, and embarked for Italy; in his voyage he was encountered at sea by a Carthaginian fleet, which sunk a number of his vessels and dispersed the rest, so that he reached a port in Italy with no more than twelve sail. Six years did he consume in Italy and Sicily, inflicting and suffering all the evils of war, and finally exhausted in force, and with diminished reputation. His restless spirit was not subdued; and for the purpose of employing and paying his soldiers, in conjunction with a body of Gauls, he made an irruption into Macedonia, where Antigonus Gonatus then reigned. His success was beyond his expectations, for he not only obtained the pillage of many cities, but defeated Antigonus in battle, and wrested from him almost the whole kingdom. He now marched with a powerful army into the Peloponnesus, at the request of Cleonymus, and appearing before Sparta, required the inhabitants to receive his friend as their king. Upon their determination to resist this mandate, he attacked the city, but was repulsed with the loss of many men: he now retired to Argos, where, through the treachery of Aristeus, a bloody conflict ensued, during which, a woman, who saw Pyrrhus just going to kill her son, hurled a tile from the top of the house, which brought the king to the ground. In this state a Macedonian dragged him to a porch, and was going to cut off his head, when Pyrrhus opened his eyes, and gave him so fierce a look, that his trembling hand failed in its office, and it was not till after repeated strokes, that he could execute his purpose. Thus in the year 272 B.C. terminated the life and exploits of this great warrior, whose career of restless enterprize death alone could stop. His military skill was held in the highest estimation by the Romans, who were so well able to judge of it by experience. Hannibal considered Pyrrhus as second only to Alexander, as a great general. He is said to have been the first who understood the art of encampments, and of properly drawing up an army, and some treatises which he wrote on these subjects are mentioned by the ancients. He was brave to the borders of rashness, and sometimes lost the commander in the soldier. He had unbounded ambition, and a disposition perpetually to engage in new enterprizes, for which, as we have seen, he readily abandoned such as proved more difficult than he had expected. He was fond of glory, but was possessed of generosity, which disposed him to acts of kindness, and to a grateful acknowledgment of obligations. All his sons were warlike, and he encouraged the disposi-

tion by the declaration, that he would leave the kingdom of Epirus to him who had the sharpest sword.

PYRRHIUS Campus, or *Pyrrhon Pedium*, in *Ancient Geography*, a canton of Africa, in Mauritania Tingitana, in the country of the Nectiberes, according to Ptolemy.

PYRRHIUS Campus, a canton of Africa, in Interior Libya, between the country of the Leucæthiopes and that of the Perorsi, according to Ptolemy.

PYRRHUS Mons, a mountain of India, on the sea-coast, on this side of the Ganges, according to the Periplus of Arrian.

PYRRSTEIN, in *Geography*, a town of Austria; 10 miles N.W. of Lintz.

PYRSEPHORUS, Πυρσεφορος, in the Athenian festival, Hephæstia, the same with Lampadephorus.

PYRULARIA, in *Botany*, so called, as it seems, because the fruit resembles a little pear, Michaux *Boreali-Amer.* v. 2. 231; has received a new appellation from Willdenow in his v. 4. 1114, *Hamiltonia*, which Mr. Pursh adopts, in his *Flora*, 178.—This genus, referred by Michaux and Willdenow to *Dioecia Pentandria*, is placed by Pursh in *Pentandria Monogynia*, though he allows it to be dioecious. It is said to be allied to *Nyssa*. See that article.

Ess. Ch. Calyx superior, five-cleft. Corolla none. Nectary a five-toothed disk. Drupa. Flowers dioecious.

1. *Hamiltonia oheifera* of Pursh, *Pyrrularia pubera* of Michaux, is the only known species, a native of shady woods, on the mountains of Pennsylvania, in Virginia, near the sweet springs, and in Carolina, flowering in May and June. This is a *shrub*, from four to six feet high, very downy, with alternate, oblong, pointed, entire leaves. *Stipulas* none. *Flowers* very small, greenish-yellow, in terminal clusters. *Fruit* known in North America by the name of Oil-nut. The root is said by Michaux to have an unpleasant smell.

PYRUS, an ancient Latin name, which botanists have adopted, but of which the most correct orthography perhaps would be *Pirus*. This will appear as we trace its etymology, but more trouble than good would now arise from such a correction. The generality of critics have given rather a forced derivation of this word, from its Greek synonym, *πυρ*, the *a* being supposed cut off, and an *r* introduced; but De Theis has proposed a much more probable one, from the Celtic *peren*, whence the Anglo-Saxons have taken *pere*, the English *pear*, and the French *poire*. According to the same writer, *api*, the Celtic name of a fruit of the same kind, is the origin of the Greek *πυρ*, the German *apfel*, and our *apple*. *Api* is even the particular name of one sort of apple, in the French language.—Linn. Gen. 251. Schreb. 339. Willd. Sp. Pl. v. 2. 1012. Mart. Mill. Dict. v. 3. Sm. Fl. Brit. 531. Prodr. Fl. Græc. Sibth. v. 1. Ait. Hort. Kew. v. 3. 207. Pursh 339. Juss. 335. Tourn. t. 404. Lamarck Illustr. t. 435. Gærtn. t. 87. (Malus; Juss. 334. Tourn. t. 406. Cydonia; Juss. 335. Tourn. t. 405. Sorbus; Linn. Gen. 250. Schreb. 338. Juss. 335. Lamarck Illustr. t. 434. Cratægus; Linn. Gen. 250. Schreb. 338. Juss. 335. Lamarck Illustr. t. 433.)—Class and order, *Icosandria Pentagynia*. Nat. Ord. *Pomaceæ*, Linn. *Rosaceæ*, Juss.

Gen. Ch. Cal. Perianth superior, of one leaf, concave, with five spreading segments, permanent. Cor. Petals five, roundish, concave, inserted by their claws into the calyx. Stam. Filaments twenty, awl-shaped, shorter than the corolla, inserted into the calyx; anthers simple, roundish. Pist. Germen inferior, roundish; styles from two to five, thread-shaped, the length of the stamens; stigmas bluntish.

Peric.

Peric. Apple roundish, umbilicated, fleshy, with from two to five membranous, more or less rigid, cells. *Seeds* two, rarely more, in each cell, oblong, obtuse, pointed at the base, convex on one side, flat on the other.

Eff. Ch. Calyx five-cleft. Petals five. Apple inferior, of from two to five cells. *Seeds* two in each cell.

Our remarks under the article *MESPILUS* apply equally to the present genus, as to the propriety of referring to it the whole Linnaean genus of *Sorbus*, and some species of *Crataegus* and *Mespilus*; disregarding the difference in the number of their styles, which is evidently uncertain and variable, and distinguishing *Mespilus* by its berry, *Pyrus* by its apple. Even this distinction proves, in some instances, obscure enough. We shall, for convenience, follow Willdenow in the order of the species, introducing our additional ones according to their affinities.

1. *P. arbutifolia*. Arbutus-leaved Dwarf Apple. Linn. Suppl. 256. Willd. n. 1. Ait. n. 1. Pursh n. 1. Wangenh. Amer. 89. t. 28. f. 64. (*Mespilus arbutifolia*; Linn. Sp. Pl. 685. *Crataegus virginiana*, foliis arbuti; Mill. Ic. t. 109.)—Leaves obovate, pointed, ferrated; downy beneath; their mid-rib glandular above. Flowers corymbose. Calyx downy.—Common in low copses and swamps, from Canada to Carolina, flowering in May and June. *Pursh.* Frequent in gardens. A bushy shrub, without thorns, three or four feet high. *Leaves* two inches long, neatly ferrated, more or less downy. *Flowers* white, terminal. *Fruit* red, the size of a currant, mealy, and not eatable.

2. *P. melanocarpa*. Black Bilberry Apple. Willd. Enum. 525. Pursh n. 2. (*P. arbutifolia* β; Willd. Sp. Pl. n. 1. and Ait. n. 1. *Mespilus arbutifolia*; Schmidt Arb. 86. *Pursh.*)—Leaves obovate-oblong, pointed, ferrated; smooth beneath; their mid-rib glandular above. Flowers corymbose. Calyx smooth.—Found in the bogs of Canada, and on the high mountains of Pennsylvania, Virginia, and Carolina, flowering in May and June. The fruit is large and black, resembling in taste the berries of *Vaccinium pennsylvanicum*. *Pursh.*

3. *P. Botryapium*. Snowy Berry Apple. Linn. Suppl. 255. Willd. n. 2. Ait. n. 2. Pursh n. 3. Wangenh. Amer. 90. t. 28. f. 65. (*Mespilus canadensis*; Linn. Sp. Pl. 685. Schmidt Arb. t. 84.)—Leaves oblong-elliptical, ferrated, minutely pointed, finally smooth. Flowers racemose. Petals linear-lanceolate. Germen downy. Segments of the calyx smooth.—Native of woods and hedges from Canada to Carolina, blossoming in April and May. *Pursh.* Frequent in our shrubberies. A small tree. The young leaves are covered with dense woolly deciduous down. *Flowers* pure white, in lax terminal clusters. *Fruit* black, said by Mr. Pursh to have a very agreeable taste. It is seldom perfected with us.

4. *P. ovalis*. Oval Berry Apple. Willd. n. 3. Pursh n. 4. (*Mespilus Amelanchier*? Walt. Carol. 148. *Crataegus spicata*; Lamarck Dict. v. 1. 84.)—Leaves roundish-elliptical, acute, ferrated, smooth. Flowers racemose. Petals obovate. Germen and segments of the calyx downy.—Native of swamps, from New Jersey to Carolina, flowering in April and May. A small shrub; the fruit black, eatable. *Pursh.* Lamarck, who first distinguished this species, says it is twice or thrice as tall as the following, at least in the French gardens, with rounder leaves and smaller flowers, while the fruit is larger, being as big as a sloe. The narrow coloured deciduous bractées moreover, which occur in both species, are in the present longer than each partial flower-stalk, which is not the case with *P. Amelanchier*.

5. *P. Amelanchier*. Alpine Berry Apple. Linn. Suppl. Vol. XXIX.

256. Willd. n. 4. Ait. n. 3. (*Mespilus Amelanchier*; Linn. Sp. Pl. 685. Jacq. Austr. t. 300. Mill. Ic. t. 178. f. 1. *Vaccinia alba*; Ger. Em. 1416.)—Leaves roundish-elliptical, acute, ferrated; downy beneath. Flowers racemose. Petals lanceolate. Germen somewhat downy. Segments of the calyx smooth.—Native of rocky mountainous situations in Germany, Switzerland, France, and the isle of Crete; common in shrubberies, ever since Gerarde's time, blossoming in May. From three to six feet high, or more when cultivated, making an elegant appearance with its copious drooping clusters of snowy flowers, whose stalks are very woolly. *Fruit* blueish-black, sweet, the size of a currant.

6. *P. cretica*. Cretan Berry Apple. Willd. n. 5. Prodr. Fl. Græc. n. 1157. (*Chamaecerasus Idæa*; Alpin. Exot. 4.)—Leaves roundish, emarginate, with a small point, ferrated; woolly beneath. Flowers racemose. Petals lanceolate. Germen and segments of the calyx woolly.—Found on the mountains of Crete. This differs from the last, of which it is justly suspected of being a mere variety, in having rounder leaves, whose pubescence underneath is more permanent; as well as in having more woolliness about the flowers.

7. *P. sanguinea*. Red Berry Apple. Pursh n. 5. (*Mespilus canadensis* γ, rotundifolia; Michaux Boreali-Amer. v. 1. 291.)—"Leaves oval, obtuse at each end, pointed, finely ferrated; somewhat heart-shaped at the base. Clusters of few flowers. Calyx smooth. Petals linear, obtuse."—Found in Canada, and on the banks of the Columbia, flowering in April and May. A small tree, with blood-red branches. *Fruit* red, eatable. *Pursh.*

8. *P. communis*. Common Pear-tree. Linn. Sp. Pl. 686. Willd. n. 6. Ait. n. 4. Sm. Fl. Brit. n. 1. Engl. Bot. t. 1784.—Leaves ovate, ferrated, finally smooth. Flower-stalks corymbose. Fruit elongated at the base.—Native of various parts of Europe, but even more general as a cultivated plant, the varieties of whose fruit are many of them highly valuable for the table. The truly wild, or iron, pear is not eatable. It blossoms in April or May. The tree is tall and handsome; the wood light, fine-grained, and tolerably hard, making neat furniture. The branches, at first erect, subsequently become curved downwards, and pendulous. The serratures of the leaves commonly disappear by culture, as do the strong thorns found on the wild tree. When young, the leaves are downy beneath, and fringed with white. *Flowers* white, with pale red anthers; their inflorescence corymbose, not umbellate as in the apple. *Fruit* obovate, more or less elongated at the base.

9. *P. pollveria*. Woolly-leaved Pear-tree. Linn. Mant. 2. 244. Willd. n. 7. Ait. n. 5. (*P. pollwilleriana*; Bauh. Hist. v. 1. 59. Munch. Hausf. v. 3. part 2. 333.)—Leaves ovate, strongly ferrated; most downy beneath. Flower-stalks corymbose, subdivided.—Native of Germany, according to baron Munchhausen. John Baubin first met with it in the garden of baron Pollwill, in Alsatia. It was sent to Kew, in 1786, by the late Mr. Græffer. This differs from the common Pear-tree in having the leaves downy on both sides, but especially beneath; the flowers cream-coloured, much smaller and more numerous, even forty in each corymb, their partial stalks being branched and forked. The fruit is small, sometimes but an inch long, and falls easily when ripe.

10. *P. nivalis*. Snow Pear-tree. Jacq. Austr. v. 2. 4. t. 107. Linn. Suppl. 253. Willd. n. 8.—Leaves obovate, obtuse, pointed, entire; hoary beneath. Flower-stalks corymbose. Fruit nearly globose.—Native of mountains in Austria, about the borders of woods and vineyards, flowering

flowering early in May. The *leaves* are whitish and silky beneath; nearly smooth above. *Flowers* large, white, strongly scented, in a simple downy *corymb*. *Fruit* about two inches in diameter, globose, rather depressed, purplish-green. When gathered in October, as austere as an unripe medlar; but after lying a few weeks, it first acquires a sweet scent, which is but temporary, and at length towards December, these pears become soft, like medlars, and very good eating.

11. *P. Malus*. Common Apple, or Crab-tree. Linn. Sp. Pl. 686. Willd. n. 9. Ait. n. 6. Sm. Fl. Brit. n. 2. Engl. Bot. t. 179. Fl. Dan. t. 1101. Mill. Illust. t. 44. (*Malus sylvestris*; Ger. Em. 1461.)—Leaves elliptic-oblong, pointed, ferrated, smooth. Umbels simple, sessile. Styles smooth.—Native of woods and hedges throughout Europe, and still more valuable, for its innumerable and useful varieties, as a cultivated plant, than even the Pear, n. 8. The Crab itself, or Wild Apple, though always too austere to be eaten raw, is subject to some varieties that are worthy of notice for kitchen use. This species produces its elegant bluish-coloured blossoms in May. The *branches* are more horizontal than those of *P. communis*, as well as more twisted and disorderly. The younger *leaves* are downy beneath. *Fruit* roundish, concave, or umbilicated, at the base.

12. *P. dioica*. Dioecious Pear-tree. Willd. n. 10. Phytogr. fasc. 1. 8. Moench. Weissenf. 87. t. 8. Willd. (*Malus non florens, fructificans tamen*; Bauh. Pin. 433.)—Leaves oval, pointed, ferrated. Flowers axillary, dioecious. Petals linear, the length of the calyx.—The native country of this singular plant is unknown. Professor Willdenow, from whom we have dried specimens, suspects it to be possibly a variety of the preceding species. The *flowers* are small, forming in appearance short downy umbels, at the ends of the branches, but each separate stalk is accompanied by a leaf. *Petals* yellowish-green, not exceeding the calyx. *Styles* five, smooth. We have seen the female plant only.

13. *P. spectabilis*. Chinese Apple-tree. Ait. n. 7. Willd. n. 11. Curt. Mag. t. 267. Schneev. Ic. t. 15.—Leaves oval-oblong, ferrated, smooth. Umbels simple, sessile, nearly smooth, without bractæas. Styles woolly at the base.—Native of China, from whence Dr. Fothergill is said to have imported it in 1780. The tree proves tolerably hardy in our gardens, flowering early in May. The *leaves* are furnished with copious shallow ferratures, and have downy *footstalks* and *ribs*. The *umbels* are nearly, if not quite, smooth, and consist of eight or ten large and handsome rose-coloured *flowers*, for which alone this plant is cultivated, the *fruit*, which is yellow, an inch in length, and usually elongated a little at the base, being sparingly produced, and of no value. We can discover no *bractæas*, and if we are not mistaken, the want of them affords the surest mark of distinction between this species and the two following.

14. *P. prunifolia*. Siberian Crab-tree. Willd. n. 12. Ait. n. 8. (*P. Malus* β; Ait. ed. 1. v. 2. 175. *Cratægus cerasi folio, floribus magnis*; Mill. Ic. t. 269.)—Leaves ovate, pointed, with shallow ferratures. Umbels simple, sessile, downy. Bractæas linear, toothed, deciduous. Styles woolly at the base.—Native of Siberia, according to Miller, who says the seeds were sent from Dauria to Peterburgh, and who had it, bearing flowers and fruit, at Chelsea, before the year 1758. This tree is now common in gardens, the fruit, which resembles a white-heart cherry in size and colour, but which is liable, in both respects, to vary, being esteemed for preserving, as well as for tarts; nor is it, when mellowed by frost, unpleasant to eat raw.

The *leaves* are rather more downy than the last, but their ribs are smooth. *Flowers* copious, with a light sweet scent, their colour much paler and their size smaller than *P. spectabilis*. *Flower-stalks* very downy. Bractæas smooth, membranous, very narrow, above half an inch long.

15. *P. baccata*. Small-fruited Crab-tree. Linn. Mant. 75, excluding the reference to Miller. Willd. n. 13. Ait. n. 9. Pall. Ross. v. 1. p. 1. 23. t. 10. Gileke Ic. fasc. 1. t. 12. (*Cratægus cerasi foliis, floribus magnis*; Amm. Ruth. 195. t. 31.)—Leaves ovato-lanceolate, pointed, sharply ferrated, smooth. Umbels smooth, simple, sessile. Bractæas linear, slightly toothed, deciduous. Styles naked.—Fruit smaller than the petals.—Found in low situations, about the banks of rivers, in Siberia, flowering the end of May. We received specimens from the garden of the late Right Hon. Charles Greville, at Paddington, in flower April 21, 1803. This differs from the last, with which some botanists have confounded it, in having broader, more acutely ferrated, smoother *leaves*; smooth *flower-stalks* and *styles*; and a small red *fruit*, not bigger than a common haw. The *calyx* in both is deciduous, leaving a scarred hollow on the top of the *fruit*.

16. *P. coronaria*. Sweet-scented Crab-tree. Linn. Sp. Pl. 687. Willd. n. 14. Ait. n. 10. Pursh n. 7. Kalm's Travels, English edition, v. 2. 166.—Leaves broad-ovate, somewhat lobed or angular, ferrated, smooth. Flower-stalks corymbose. Styles woolly in the lower part.—Native of woods in North America, from Pennsylvania to Carolina, flowering in May. It has long been cultivated in England, for the sake of the beauty and violet-like fragrance of its bluish-coloured blossoms, as well as for its *fruit*, which is as big as a small golden-pippin, extremely acid, but excellent for preserving with sugar. The *leaves* are distinguished by their breadth, and by being slightly lobed, like some of the less deeply cut leaves of the Hawthorn, but thrice as large.

17. *P. angustifolia*. Narrow-leaved Crab-tree. Ait. Hort. Kew. ed. 1. v. 2. 176. ed. 2. n. 11. Willd. n. 15. Pursh n. 8. (*P. coronaria*; Wangenh. Amer. 61. t. 21. f. 47.)—Leaves lanceolate-oblong, shining, with tooth-like notches; contracted and entire at the base. Flower-stalks corymbose. Found in the low woods of Carolina, flowering in May. It resembles the foregoing species, but the *fruit* is very small. Pursh. This is said in Hort. Kew. to have been cultivated in 1750, by Mr. Christopher Gray. We have never examined it, nor have we any account of the *styles* being downy or otherwise.

18. *P. japonica*. Japan Apple-tree. Thunb. Japon. 207. Willd. n. 16. Ait. n. 12. Curt. Mag. t. 692. (*Malus Japonica*; Andr. Repos. t. 462. Buke; Kämpf. Amoen. 844.)—Leaves elliptic-oblong, sharply ferrated, very smooth. Stipulas lunate, deeply toothed. Flower-stalks somewhat aggregate. Calyx abrupt. Seeds numerous in each cell.—Gathered by Thunberg, on mount Fakona in Japan, where it flowers from February to April. It proves quite hardy in our gardens, into which Sir Joseph Banks introduced it in 1796, flowering at the same season, and also frequently again in autumn. When the spring is severe, the beautiful deep scarlet blossoms require the shelter of a glass frame. The *stem* is somewhat thorny. *Leaves* deep green; the first that come out are short and abrupt. Stipulas on the young branches, half an inch or an inch broad. *Fruit* globular, we have not seen it ripe. *Seeds* very numerous in each cell, one above another, so that we cannot but feel some scruples as to the genus of this species.

19. *P. Cydonia*. Common Quince-tree. Linn. Sp. Pl. 687. Willd. n. 17. Ait. n. 13. Jacq. Austr. t. 342.

Woodv. Med. Bot. t. 79. (*Malus cotonea*; Ger. Em. 1452. Matth. Valgr. v. 1. 217.)—Leaves roundish-elliptical, entire; downy beneath. Flowers solitary, stalked. Calyx ferrated, reflexed.—Native of the rocky banks of the Danube. Naturalized in the hedges of Germany. Dr. Sibthorp found it wild in the northern parts of Greece, in which country it retains the ancient name *κυδανιά*. This was among the first exotic fruits cultivated in England, where it blossoms in May or June, and ripens fruit in autumn. The tree is rather spreading than tall. Leaves roundish, various in size; smooth and light green above; white with soft dense down beneath. Flower-stalks and calyx more or less woolly. Petals large, flesh-coloured. Fruit large, yellow, very austere and astringent, but with a peculiar and very powerful fragrance. Cookery renders it mild, and to most persons highly grateful. There are three or four angular seeds in each cell, ranged horizontally, not, as in the last, vertically. The Quince is supposed to be the golden apple of the Hesperides, so famous in ancient fable.

20. *P. salicifolia*. Willow-leaved Crab-tree. Linn. Suppl. 255. Willd. n. 18. Ait. n. 14. Pallas Ross. v. 1. p. 1. 20. t. 9.—Leaves linear-lanceolate, hoary, nearly entire; downy beneath. Flowers solitary, almost sessile.—Native of Siberia, America, and mount Hæmus. Sent to Kew, by Pallas, in 1780. It is a hardy tree, flowering early in spring, and known by its hoary, narrow, willow-like leaves. The flowers are terminal, solitary, and nearly sessile; not axillary. Fruit pear-shaped, an inch long, brown, not at all eatable till mellowed by frost, like medlars; and even then not very good.

21. *P. Chamæspilus*. Bastard Quince. Ehrh. Beitr. fasc. 4. 19. Sm. Prodr. Fl. Græc. Sibth. n. 1158. (Mespilus Chamæspilus; Linn. Sp. Pl. 685. Willd. Sp. Pl. v. 2. 1011. Ait. Hort. Kew. v. 3. 206. Cratægus Chamæspilus; Jacq. Austr. t. 231. Cotanaster Gefneri; Ger. Em. 1606.)—Leaves elliptical, sharply serrated, smooth. Flowers in corymbose heads. Calyx very woolly within. Styles two, smooth.—Native of the alps of Austria, Savoy, and Switzerland, as well as of mount Athos, and the Pyrenées, flowering in June. A bushy shrub; the leaves two or three inches long and one wide; entire at the base; of a deep shining green; their under side paler, marked with many transverse parallel veins. Flowers small, deep rose-coloured. Calyx very densely lined with long white wool. Styles and seeds but two. Fruit corymbose, oval, of an orange scarlet, the size of a haw.

22. *P. Aria*. White Beam-tree, or White Wild Pear-tree. Ehrh. Beitr. fasc. 4. 20. Arb. 84. Sm. Fl. Brit. n. 7. Engl. Bot. t. 1858. Willd. n. 19. Ait. n. 15. (Cratægus Aria; Linn. Sp. Pl. 681. Fl. Dan. n. 301. t. 302. Aria Theophrasti; Ger. Em. 1327.)—Leaves elliptical, cut, and serrated; white and downy beneath, with crowded parallel veins. Corymbs compound, woolly. Styles two or more.—Native of limestone rocks, or chalky hills, in most parts of Europe; not rare in the mountainous countries of England, flowering in May, ripening fruit in September. A handsome small tree, much cultivated in home plantations. The young branches, like the stalks, calyx, and backs of the leaves, are very white, with mealy or cottony down. The leaves vary from an ovate or obovate figure, to a more correct oval, and are pretty regularly cut, as well as serrated, but not sinuated or lobed; their veins, or side-ribs, numerous, straight and parallel; their upper side smooth. Corymbs subdivided, many-flowered, cottony. Petals white, the size of those of the Hawthorn. Styles two, often three, rarely four. Fruit nearly globular, scarlet, dotted, mealy and acid; its cells coriaceous rather

than horny, equal in number to the styles, with two seeds in each.

23. *P. intermedia*. Swedish White Beam-tree. Ehrh. Beitr. fasc. 4. 20. Arb. 94. Willd. n. 20. Arb. 268. Ait. n. 16. (*Sorbus alpina*, foliis sinuosis; Fl. Dan. n. 302. t. 301. fig. in flower only. *S. hybrida*; Hudf. 216.)—Leaves elliptical, lobed, cut and serrated; white and downy beneath, with rather distant veins. Corymbs compound, woolly. Styles two or more.—Native of Sweden. Found by Mr. Waring, on the walls of castle Dinas y Brân, North Wales. Hudson. Specimens from the original plant prove the same as those of Ehrhart, and differ from the common *P. Aria*, only in having the leaves so far cut, as to be, in some degree, pinnatifid, owing to which the transverse veins are rather more distant from each other. We can scarcely admit it to be more than a variety, as Linnæus made it in Sp. Pl. 681. It is his Lapland plant, Fl. Lapp. n. 199.

24. *P. pinnatifida*. Ballard Mountain Ash. Ehrh. Beitr. fasc. 6. 93. Exficc. 145. Sm. Engl. Bot. t. 2331. (*P. hybrida*; Sm. Fl. Brit. n. 6, excluding the synonyms of Hudson and Withering. *Sorbus hybrida*; Linn. Sp. Pl. 684. Linn. Fil. fasc. 1. t. 6. Willd. Sp. Pl. v. 2. 1008. Ait. Hort. Kew. v. 3. 204. Fl. Dan. n. 302. t. 301. fig. in fruit.)—Leaves oblong, deeply pinnatifid, or half pinnate; downy beneath. Corymbs compound, woolly. Styles about three.—Native of Sweden. Gathered wild, by the late Mr. J. Mackay, in rocky places on Cairn na Callich, and other mountains, at the north end of the isle of Arran. It is frequent in plantations, flowering in May, and propagated by seed. This was thought by Linnæus to be a mule, between *Aria*, and *aucuparia* hereafter mentioned. It nearly accords with the former, but the leaves are more oblong and acute; very deeply pinnatifid, or even pinnate, in their lower part. The flowers and fruit almost agree with those of *aucuparia*. The styles are usually three or four.

25. *P. aucuparia*. Mountain Ash; Quicken, or Roan Tree. Ehrh. Beitr. fasc. 6. 94. Gærtn. v. 2. 45. t. 87. Sm. Fl. Brit. n. 5. (*Sorbus aucuparia*; Linn. Sp. Pl. 683. Willd. Sp. Pl. v. 2. 1008. Ait. Hort. Kew. v. 3. 204. Fl. Dan. t. 1034. Mill. Illust. t. 43. Engl. Bot. t. 337. *S. sylvestris*; Ger. Em. 1473. Matth. Valgr. v. 1. 238.)—Leaves pinnate; leaflets equal, serrated, smoothish. Corymbs compound, somewhat paniced. Styles about three.—Native of mountainous places, in the colder parts of Europe; abundant in Scotland, Derbyshire, &c. flowering in May, and very common in domestic plantations. An elegant and very hardy tree, of slow growth, the wood being hard and tough. Leaves all distinctly pinnate, of many pair of opposite, oblong, smooth, serrated leaflets, more or less entire towards the base, with an odd one; the young ones downy beneath. Flowers very numerous, white, the size of the three last, but rather more paniced. Fruit scarlet, acid and bitter, yet eatable when prepared with sugar. According to Lightfoot, this tree is found generally about the Druidical circles in North Britain, and is still believed, by the superstitious Highlanders, to be powerfully efficacious against witchcraft.

26. *P. domestica*. True Service Tree. Ehrh. Beitr. fasc. 6. 95. Exficc. 155. Sm. Fl. Brit. n. 4. Engl. Bot. t. 350. (*Sorbus domestica*; Linn. Sp. Pl. 684. Willd. Sp. Pl. v. 2. 1009. Ait. Hort. Kew. v. 3. 204. Jacq. Austr. t. 447. Matth. Valgr. v. 1. 237. *Sorbus*; Ger. Em. 1471.)—Leaves pinnate; leaflets equal, strongly serrated, downy beneath. Flowers paniced. Styles five.—Native of the warmer parts of Europe. Dr. Sibthorp found

found it in Greece, as well as on mounts Hæmus and Athos, and in woods near Constantinople. Ray speaks of it as wild in the mountainous parts of Cornwall and Staffordshire. It is now rarely cultivated, being, though a handsome tree, yet of slow growth, and inferior in the value of its fruit to the Medlar. A solitary individual of this species now and then occurs, about ancient mansions and very old orchards. It blossoms in May. The leaves are larger, and the flowers twice the dimensions of the last, being the size of hawthorn-blossoms, rather paniced than corymbose. Fruit like a small pear, reddish, above an inch long, with five cells, answerable to the five styles; its cells with two valves, like those of a Common Pear; and though only one seed is perfected in each cell, Gærtner observed two in an early state. This fruit, if tasted before it is mellow, occasions a most intolerable forens at the back of the palate, lasting many hours. When ripe it is soft, brown, and agreeably acid. The name *Service* is evidently a corruption of *Sorbus*.

27. *P. torminalis*. Wild Service Pear-tree. Ehrh. Beitr. fasc. 6. 92. Sm. Fl. Brit. n. 3. Willd. Sp. Pl. n. 21. Ait. n. 17. (*Cratægus torminalis*; Linn. Sp. Pl. 681. Engl. Bot. t. 298. Fl. Dan. t. 798. Jacq. Austr. t. 443. Mill. Illustr. t. 42. *Sorbus torminalis*; Ger. Em. 1471. Matth. Valgr. v. 1. 239.)—Leaves simple, somewhat heart-shaped, serrated, acute, smooth, seven-lobed; the lower lobes spreading.—Native of Germany, Switzerland, England, and the Levant, in woods, flowering in April or May. A moderate-sized tree, with a hard wood, and smooth bark. Leaves on long stalks, without stipulas, unequally lobed, pointed; their ribs sometimes downy beneath. Corymbs downy, much branched. Flowers smaller than the last. Styles three, four, or five. Fruit brown, dotted, twice the size of a haw, very pleasantly acid and pulpy, when touched by frost, and often sold in the London fruit-shops. By the specific name, it should seem to be of a gripping quality. Tragus, in his p. 1010, represents it as powerfully expelling worms.

28. *P. hybrida*. Mule Service Pear-tree. Willd. n. 22. Moench. Weissenf. 90. t. 6. Willd.—Leaves elliptical, serrated, downy beneath; simple or pinnate, the terminal one largest. Flowers corymbose. Calyx hairy.—This is asserted by Professor Willdenow, from whom we have specimens, to be a mule production, from the first species, *P. arbutifolia*, impregnated by the 25th, *aucuparia*. It retains indeed as great a resemblance to both parents as it possibly could to what are so dissimilar to each other. The simple leaves are two inches or more in length, obtuse, strongly serrated; the lateral leaflets, of the compound ones, half, or one-third, as large, unequal at the base. Stipulas ovate, toothed, recurved. Flowers not much unlike the last, but their cymes somewhat smaller, with hairy, rather than downy, stalks. It is curious that the rib of each leaf, on its upper side, retains some portion of the brown glands characteristic of *P. arbutifolia*.

29. *P. anthyllidifolia*. Kidney-vetch-leaved Service-tree.—Leaves pinnate, entire; silky beneath. Corymbs axillary and terminal, of few flowers.—Gathered in the Sandwich islands, by Mr. Menzies, to whom we are obliged for specimens, under the name of *Sorbus*, to which, now abolished, Linnæan genus there can be no doubt that this tree belongs, though we have not seen the fruit. The leaves are all uniformly pinnate, two or three inches long, of eight or nine pair, besides an odd one, of equal, oblong or obovate, obtuse, minutely pointed, entire leaflets, half an inch at least in length; smooth and shining above; paler and silky beneath. Stipulas lanceolate, a little hairy, deciduous.

Flower-stalks axillary and terminal, nearly the length of the leaves, downy, corymbose, though each bears but three or four flowers, which are about the size of *P. aucuparia*. Bractæes awl-shaped. Calyx woolly. Styles, as far as we can see, three, hairy at the base. The leaves of this very pretty and remarkable species strikingly convey the idea, at first sight, of some kind of *Anthyllis*, especially *A. Barba Jovis*.

PYRUS, in *Gardening*, contains plants of the fruit-tree kind, of which the species cultivated are the common pear-tree (*P. communis*); the common apple-tree (*P. malus*); the Chinese apple-tree (*P. spectabilis*); the Siberian crab-tree (*P. prunifolia*); the sweet-scented crab-tree (*P. coronaria*); and the quince-tree (*P. cydonia*.)

With respect to the first, it is observed that "the wild pear, the mother of all the orchard and garden varieties, is thorny. The stipules are setaceous, white (or reddish), deciduous; the peduncles alternate; and the calyx clothed with a ferruginous wool."

There are numerous varieties; but those of most importance for cultivation are,

The little musk, which is often termed the supreme. The fruit, when ripe, is of a yellow colour; the juice somewhat musky; and, when gathered before it be too ripe, it is a good fruit. It becomes ripe about the latter end of July, but continues good only a very short time.

The chio, or little bastard musk, which is pretty much like the other, but smaller. The skin, when ripe, has a few streaks of red on the sun side.

The green chissel, or Hastings, which is a middle-sized fruit, that always remains green, and is full of juice when ripe. It becomes ripe in the beginning of August.

The red muscadelle, which is a large early pear, of great beauty; the skin is of a beautiful yellow, striped with red, and the flesh has a rich flavour. It sometimes produces two crops in a year; the first about the end of July, and the second in September, or thereabouts.

The little muscat, which is a small pear, having the skin very thin, and of a yellowish colour, when ripe. This fruit has a rich musky flavour, but does not keep long. It becomes ripe about the beginning of August.

The lady's thigh, which is here commonly called jargonelle, is of a russet-green colour from the sun, but towards it inclining to an iron colour; the flesh is breaking, and has a rich musky flavour. It becomes ripe about the middle of August.

The Windsor, which has a smooth skin, and when ripe is of a yellowish-green colour; the flesh is very soft, and, if permitted to hang but two or three days after it is ripe, grows mealy, and is good for nothing. It becomes ripe about the latter end of August.

The jargonelle, which is commonly called cuisse madame. According to Mr. Forsyth, it is certainly the true French jargonelle, and the pear that commonly goes by that name here is the real cuisse madame, or lady's thigh; it being very probable that the names have been changed, in coming to this country. This pear is somewhat like the Windsor; the skin is smooth, and of a pale green colour. It is a plentiful bearer; but the flesh is apt to be mealy, if it stands to be ripe, which is about the middle of August. It bears best on standards.

The orange musk, which is of a yellow colour, spotted with black; the flesh is musky, but very apt to be dry. It ripens about the latter end of August.

The great blanquet, or bagpipe of Anjou, which has a smooth skin of a pale green colour; the flesh is soft, and full

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full of juice of a rich flavour. It ripens about the middle of August.

The little blanquet, which is much less than the former, of a pale colour, and the flesh tender, and full of a rich musky juice. It ripens about the latter end of August.

The long-stalked blanquet has a very smooth skin, white, and a little coloured towards the sun, and is full of a rich fugary juice. It becomes ripe at the latter end of August.

The skinless or early ruffelet, which is of a reddish colour, the skin extremely thin, and the flesh melting and full of a rich fugary juice. It ripens in the latter end of August.

The musk robine, or queen's pear, (also called the amber pear,) which is small, and of a yellow colour when ripe; it has a rich musky flavour, and is a great bearer. It ripens about the latter end of August.

The musk drone, which has a skin of a yellow colour when ripe, and a rich musky taste; but is apt to grow mealy, if left too long on the tree. It ripens about the beginning of September.

The red orange, which is of a greenish colour, but the side next the sun changes to a purple colour, when ripe; the flesh is melting, and the juice fugary, with a little perfume. It ripens in the beginning of August.

The callolette, or green muscat, is a small greenish pear, with some specks in the skin. It is full of a rich perfumed juice, and ripens in the latter end of September.

The great onion, brown admired, or king of summer, which is of a brownish colour next the sun, and becomes ripe in the beginning of September.

The musk orange, in which the skin is green, and the flesh melting. It ripens in the beginning of September.

The avorot, or August muscat, which has a smooth skin of a whitish yellow colour; the juice is richly sugared and perfumed, and it is esteemed one of the best summer pears yet known. It is a great bearer, and becomes ripe in the beginning of September.

The rose, or thorny rose, which is shaped like the great onion pear, but much larger, of a yellowish-green colour, but a little inclining to red next the sun. The flesh is breaking, and the juice musky. It becomes ripe in the beginning of September.

The poire du puchet, which has the flesh soft and tender, and the juice fugary. It ripens in the beginning of September.

The perfumed pear, which is of a deep red colour, spotted with brown; the flesh melting, but dry, and has a perfumed flavour. It ripens in the beginning of September.

The salviati, which is red and yellow next the sun, but whitish on the other side; the flesh is tender, and the juice fugary and perfumed. It ripens about the middle of September.

The rose water, which has the skin rough, and of a brown colour, the juice very sweet, tasting like rose-water. It ripens in the latter end of September.

The ruffelet, in which the flesh is soft and tender, and the juice agreeably perfumed. It ripens in the latter end of September.

The great mouthwater, which has the flesh melting and full of juice. It ripens about the latter end of September.

The prince's pear, which has a highly-flavoured juice, and is a great bearer, ripening about the latter end of September.

The summer bergamot, which is sometimes called Hamden's bergamot. The flesh is melting, and the juice highly perfumed. It ripens about the latter end of September.

The autumn bergamot, which is smaller than the former;

the flesh is melting, and the juice highly perfumed. It is a great bearer, and ripens in the beginning of October.

The summer bonchrétien, which is very full of juice, and is of a rich perfumed flavour. It ripens about the middle of September.

The beurré rouge, (the red butter pear,) which has the flesh very melting and full of a rich fugary juice. It ripens in the beginning of October, and, when first gathered from the tree, is one of the very best sorts of pears.

The dean's pear, which has the flesh melting and full of juice, which is very cold. It is a great bearer, and ripens in the beginning of October.

The Swifts bergamot has a melting flesh, and is full of juice. It ripens in the beginning of October.

The long green, in which the flesh is melting and full of juice. It ripens in the latter end of October. It is, by some, reckoned the same with the mouthwater.

The white and grey monsieur John, which are the same; the difference of their colour proceeding from the different soils and situations wherein they grow, or the stocks on which they are grafted. If this pear be rightly managed, there are not many sorts in the same season to be compared with it. The flesh is breaking, and full of a rich sugared juice. It ripens in the latter end of October or beginning of November.

The flowered muscat, which is an excellent pear; the flesh is very tender, and of a delicate flavour. It ripens in November.

The vine pear, which is of a dark red colour; the flesh very melting, and full of a clammy juice. It comes into eating in November.

The roussette pear, which is of a deep red colour, with spots of grey; the flesh is very tender and delicate, and the juice very sweet, with an agreeable perfume. It ripens about the latter end of October, but does not keep.

The knave's pear, which has the flesh fine and tender, and the juice very much sugared. It ripens in the latter end of October.

The marquis pear is a pear which, when it does not change yellow in ripening, is seldom good; but if it does, the flesh will be tender, delicate, and very full of juice, which is sugared. It comes into eating in November.

The Crafane pear, which has the flesh extremely tender and buttery, and full of a rich sugared juice. It is the very best pear of the season, and comes into eating about the latter end of December.

The Lanfac, or Dauphiné pear, which has the flesh yellow, tender, and melting; the juice is sugared, and a little perfumed. It is in eating the beginning of December.

The martin sec (the dry martin), which is almost like the ruffelet in shape and colour; the flesh is breaking and fine; and the juice sugared, with a little perfume. It is in eating about the beginning of December.

The amadot, which is rather dry, but high-flavoured: it is in eating about the middle of December.

The little lard pear, which is extremely fine; the flesh melting; the juice much sugared, and has an agreeable musky flavour. It is in eating the latter end of December, and is esteemed one of the best fruits in that season.

The Louison (the good Lewis), which has the flesh extremely tender, and full of a very sweet juice. It is in eating about the middle of December.

The Colmar pear, which is very tender, and the juice greatly sugared. It is in eating about the beginning of January, and is esteemed an excellent fruit.

The Pefchafferie, which has the flesh melting and buttery; the

the juice is fugary, with a little perfume. It is in eating about the first of January. It bears best on standards.

The *virgouleuse* pear, which is esteemed by some as one of the best fruits of the season; the flesh is melting, and full of a rich juice. It is in eating about the first of January. In dry and cold seasons it is very apt to crack, which greatly diminishes its value.

The *ambrette*, which is esteemed a very good pear; the flesh is quite melting, and full of sweet perfumed juice. It comes into eating about the beginning of January.

The *epine d'hyver* (the winter thorn pear), which has a very tender buttery pulp, of an agreeable taste, with a sweet juice highly perfumed. It is in eating about the latter end of December.

The *St. Germain* pear, which is a fine fruit and keeps long; the flesh is melting, and very full of juice, which in a dry season, or if planted on a warm dry soil, is very sweet. It is in eating from December till February. Mr. Forsyth remarks, that it is "an excellent bearer, when planted as a dwarf standard, and comes in succession after the same sort of pears on wall-trees are over."

The *St. Aulin*, which is pretty full of juice, and which is often a little sharp; the flesh is tender but not buttery. It is in eating the latter end of December, and continues good two months or longer.

The *Spanish bouchrétien*, which is a large fine pear; the flesh is breaking, and the juice sweet. It is in eating in January.

The wilding of *Cassay*, which is also called the small winter butter pear, is a small fruit; the flesh is melting, and the juice very rich: it is an excellent bearer on standards. It is in eating in January.

The *martin fire*, or the *lord martin*, which is a good fruit; the flesh is breaking and full of juice, which is very sweet and a little perfumed. It is in eating in January.

The *winter ruffelet*, which has the flesh buttery and melting, and generally full of a sweet juice. It is in eating in the latter end of January.

The *franc real*, or the *golden end of winter*, which is only esteemed for baking.

The *brown beurré*, which is of a reddish-brown colour on the side next the sun, and yellowish on the other side. The flesh is melting, and full of a rich juice. It ripens in October, and is esteemed an excellent pear.

The *Holland bergamot*, *amofelle*, or *lord Cheney's*, which is a very good pear; the flesh is half buttery and tender, and the juice is highly flavoured. It keeps from the end of January till April.

The *German muscat*, which is an excellent pear; it is buttery and tender, and the juice is highly flavoured. It is in eating from February till April or May.

The *pear of Naples*, or *Easter St. Germain*, which is half-breaking; the juice is sweet, and a little vinous. It is in eating in March.

The *winter bouchrétien*, which is very large; the flesh is tender and breaking, and is very full of a rich fugared juice. It is in eating from the end of March till June.

The *la pastorelle*, which is tender and buttery, and the juice sweet. It is in eating in March.

The *St. Martial*, or the *angelic pear*, which has the flesh tender and buttery, and the juice very sweet. It is in eating in March.

The wilding of *Chaumontelle*, which is melting, the juice very rich, and a little perfumed. It is in eating in January.

The *brown St. Germain*, which is a very fine high-flavoured

pear on dwarfs and standards, and comes in after the wall *St. Germain*. It continues in eating from December to the end of March.

The *pear d'Auch*, which was introduced by the late duke of Northumberland. It much resembles the *Colmar*, but is fuller towards the stalk. It is in eating from Christmas to April, and is, without exception, the best of all the winter pears.

The *swan's egg*, which is a middle-sized pear, in a shape like an egg; it is of a green colour, thinly covered with brown; the flesh is melting, and full of a pleasant musky juice. It comes in eating in November. It is healthy, and bears well either as a standard or in any other way.

The *bergamot de pafque*, which has also the following names: the *terling*, the *amofelle*, the *Paddington*, and the *Tarquin*. It is a fine handsome fruit, green when gathered, and of a yellowish or straw-colour when ripe. It comes into eating about the month of April, continues till June, and makes a very handsome appearance at table.

The *golden beurré*, which is a very fine pear; it is of a beautiful scarlet colour next the sun, and of a gold colour on the other side. The flesh is melting, and the juice highly flavoured. It ripens in October. It succeeds best on an east aspect, and a loamy soil. It is a plentiful bearer. Mr. Forsyth observes, that it "was introduced from Burgundy by the late marshal Conway, and was first raised, in this country, at his seat of Park Place, near Henley-upon-Thames, now the seat of lord Malmesbury."

The *Williams's feeding pear*, which resembles a summer *bouchrétien*, but is more juicy, is a great bearer, and ripens in September. Mr. Forsyth says that it "will be a valuable acquisition to the market-gardeners, as it immediately succeeds the *Windfor pear*."

The *citron de Carmes*, which is a middle-sized pear, of a yellowish-green cast, full at the eye; of a round shape, but tapering a little towards the stalk, which is long. It becomes ripe in July.

And the true *golden beurré*, which in shape and size resembles the *brown beurré*; but is of a reddish-brown colour next the sun. It is a very fine pear, but does not keep long. It comes into eating in October.

Mr. Forsyth gives the following selection from Anderson's and Co's Catalogue of Edinburgh.

Of the Summer Kinds.—The *pear James*, which is soon ripe, and soon rotten, has a little flavour, and is the earliest pear in Scotland.

The *early carnock*, which is indifferent, of a yellow colour, and bright-red towards the sun; making a beautiful standard tree.

The *lemon*, *lady's lemon*, or *lady Lamont*, which is indifferently good, but principally valued for coming early, and being a good bearer in common.

The *green pear of Pinkey*, which is a small green pear, nearly round, of a sweetish taste or flavour.

The *forrow cow*, a *Clydesdale pear*, which is a large pear with a short stalk; flat towards the eye; the colour red and yellow; the flesh tender, and musked in its flavour.

The *pear fanch*, a *Clydesdale pear*, which is a big-bellied beautiful pear; the tree large, a great bearer, and fit for an orchard; but the fruit is not very good.

The *grey honey*, which is a pretty good pear.

The *green orange pear*, or *orange vert*, which is a very good pear.

The *brute bone*, *chaw good*, or the *pope's pear*, which is only an indifferent fort.

The *golden knap*, supposed *Scotch*, which is a small summer pear, of tolerably good qualities.

The early achan, an indifferent fruit ; greatly inferior to the winter pear of that name.

The hanging leaf, which is the name in Clydesdale, is good and beautiful ; almost round ; its colour red and yellow ; a delicious sweetness is found in its taste.

The Scots bergamot, which is a large good pear, of a yellow and red colour ; the flesh tender and juicy.

The Longueville, which is very good, but a precarious bearer ; supposed French, though not in their catalogues under that name.

The musked bonchrétien, gratioli, cucumber, or Spinola's pear, which is a very good pear when grafted on a free stock ; its pulp being somewhat between short and tender, with a great deal of perfumed juice, its colour red on one side, and white on the other.

And the saffron pear, which is a pretty large well-shaped pear, fit for the orchard or the field.

Of the Autumnal Kinds.—The keather, which is a Clydesdale pear, of middling size, and oblong shape, its juice agreeable.

The French carnock, which is tolerably good.

The elshin haft, or good-man pear, which is a long pear, flat towards the eye : its colour green and yellow ; its flesh hard, dry, and sweet in the taste.

The Drummond, or late Scotch carnock, which is very good, if eaten before it grows mealy ; its colour a bright red and yellow.

The vicar, an oblong pear, with the colour yellow, red, and striped ; tender, sweet, and musked, but dry in eating.

The royal orange bergamot, which differs from the orange bergamot in being yellower, and sometimes having a faint red on one side.

The green pear of Yair, which is sweet, juicy, and melting ; of a moderate size ; taking its name from Yair, on Tweed-side, where it was first discovered.

The rob hind, which is very indifferent.

The le besideri, the wilding of the forest of Ileri, in Bretagne, which is a yellowish pear, of middle size, but which is indifferent.

The unicorn pear, which is of a beautiful red and yellow colour ; but rather austere in the taste or flavour.

Of the Winter Kinds.—The winter achan, which is a Scotch pear ; among the best early winter pears, and equal to most of those of the French kind.

The brier bush, which is Scotch ; a good pear, and will ripen in most seasons ; it is a small pear, of a firm substance, and sweet taste.

The Brompton park, which is a seedling sent by Jefferys of that name.

The round winter, which is a Clydesdale pear, a very excellent winter pear.

The poir portrail, or gate pear, which is proper for baking.

The la double fleur, or the double-flowering pear, which is a large flat beautiful pear, with a smooth skin, and blush colour on one side, and yellow on the other : it is the best to preserve, taking a beautiful red colour from the fire.

And to these the following list is added : —The Ambrosia pear, the Ashton town, the autumn musk bonchrétien, the bishop's thumb, the bloody pear, proper for baking, the brocas bergamot, the barland, proper for perry, the besideri, fit for baking, the beurré du roi, the black pear, or Worcester, fit for baking, the Britannia, the burdélien, the Doyenne, or St. Michael, the castillac, fit for baking, the Easter St. Germain, the Gansel's bergamot, the golden beurré, the grey beurré, the grey good-wife, the green

fugar, the green bergamot, the Huntingdon pear, the huffcap, proper for perry, the king's Catharine, the lammas, the London fugar, the muscat almain, the musk blanquet, the Oldfield, proper for perry, the orange bergamot, the pear piper, the pyrus pollveria, the red admirable, the rough cap, proper for perry, the Scotch bergamot, the seven-angled, the silver-striped, the Spanish red warden, best for baking, the squash, proper for perry, the striped verte longue, and the white beurré.

And for small gardens, where there is room only for a few trees, the following are recommended as proper for furnishing a regular succession of fruit.

Summer Kinds.—The musk pear, the green chissel, the jargonelle, the summer bergamot, and the summer bonchrétien.

Of the Autumn Kinds.—The orange bergamot, the autumn bergamot, the Gansel's bergamot, the brown beurré, the Doyenne, or St. Michael, and the swan's egg.

Of the Winter Kinds.—The Craffane, the Chaumontelle, the St. Germain, the Colmar, the d'Auch, the Pesehaillerie, the winter bonchrétien, and the bergamot de pasque.

And the second fort, in its wild state, is called the crab, or wilding, and is armed with thorns, as well as the wild pear. Miller mentions two varieties in the fruit of the crab, one white, the other purple towards the sun ; but it is commonly yellowish-green with a tinge of red. And also a variety with variegated leaves.

There are a great many varieties of the apple, but the following are given by Mr. Forsyth as the most deserving of attention.

The Acklam's ruffet, which is a small Yorkshire apple, of a ruffet colour toward the sun, and yellow on the other side ; it becomes ripe in January, and keeps till March.

The aromatic pippin, which is a very good apple, of a bright ruffet next the sun ; and the flesh has a fine aromatic flavour. It ripens in October.

The Baxter's pearmain, which is a real Norfolk apple, of a handsome size, and pale-green colour, full of small dark spots. It is a fine kitchen fruit, and will keep till April. It is also a good eating apple.

The beauty of Kent, which is a fine large apple, resembling a codlin. It is streaked with a fine red towards the sun, and of a beautiful yellow, with some streaks of red on the other side. It is a very good apple, coming into eating in September, and keeping till the latter end of April.

The belle griffeline, which is a new seedling raised at Norwich, of much beauty, and never failing to afford crops. It was first propagated by Mr. Lindley, who gave it this name. It is a handsome apple, resembling the burdoff, of a yellow colour, with red towards the sun, and an excellent table apple, keeping till March.

The Bell's pearmain, which is a real Norfolk apple, large and handsome ; red toward the sun, and yellow on the other side. It is a fine kitchen fruit, and pretty good to eat raw, keeping till June.

The best pool, which is a middle-sized apple, of a pale-green colour, streaked with red towards the sun. It is a good apple, in eating from January to April.

The black apple, which is a middle-sized fruit, of a dark mahogany colour next the sun, but fainter on the other side. It is of a pleasant sweet taste, keeping till the middle of April.

The Bland's summer pippin, which is a handsome apple, of a gold colour, and an agreeable flavour. It is a great bearer, ripe in September, and keeps till Christmas.

The Blatche's fine small table apple, which is about the size

size of a small golden pippin; red toward the sun, and green on the other side. It has a fugary taste, and comes into eating in January.

The boomrey, which is a pretty large handsome apple, of a flat shape, and deep-red colour; and the flesh is streaked with red. It is not fit to eat raw, but will do well for cyder, or for the kitchen. It keeps till April.

The Bovey redbreak, which is a handsome apple, of a flattish shape, beautifully streaked with a bright red next the eye, which is small, and of a yellow colour about the footstalk. It keeps till the latter end of October.

The broad-eyed pippin, which is a fine large apple, with a very large eye; the colour is a greenish-yellow, with a little red toward the sun. It is a good apple, and keeps till May.

The brandy apple, which is about the size of a golden pippin, flat-shaped, and of a yellowish russet colour. It is of a pleasant flavour; comes into eating in January, and keeps till March.

The burfordoff, or queen's apple, which is a beautiful fruit, red next the sun, and of a fine yellow on the other side. It is a very fine apple; in Mr. Forsyth's opinion, next in perfection to the golden pippin, and about the same size. It is of a good flavour; ripening in January, and keeping till March.

The carnation apple, which is a beautiful middle-sized fruit, finely striped with red. It is ripe in January, and keeps till May.

The Carbury pippin, which in size and shape resembles the French crab, and is of a deep green colour. It is a good baking apple, keeping till March.

The caraway russet, which is a handsome russet-coloured apple, about the size of a nonpareil.

The calville, red and white, which are good apples, and of a vinous taste. Some have a red and some a white pulp, the white being reckoned of a most delicious taste. They are in eating in September, and the following month.

The cat's-head, which is a large oblong apple, of a greenish-yellow colour, with a little brownish-red next the sun; sometimes the colour inclines to a russet. It is a good baking apple, and is in eating from October to December.

The cockagee, which is a conical-shaped middle-sized apple, red on that side next the sun, and of a fine yellow colour on the other. If properly managed, the fruit keeps till February. It is a famous cyder apple, and also bakes well.

The codlin, which is generally the first apple that is brought to market. Its fruit is so well known that it needs no description. It is in eating from July to December; and is good either for baking or boiling.

The Cornish nonpareil, which is rather under the middle size, is a little flattened, and of a russet colour. It is a very good apple, and keeps till the middle of March.

The Cornish pearmain, which is of a middling size, and long shape; of a dull-green colour on one side, and russet on the other. It is a very good apple, and keeps till the latter end of April.

The Court-of-Wick pippin, which is described by Mr. Billingsly, in his "Survey of Somersetshire," as "the favourite apple, both as a table and cyder-fruit, taking its name from the spot where it was first produced. It originated from the pip or seed of the golden pippin, and may be considered as a beautiful variety of that fruit. In shape, colour, and flavour, it has not its superior: the tree is large, handsome, and spreading, and a very luxuriant bearer. On the whole, it cannot be too strongly recom-

mended." It is larger than the golden pippin, of a yellowish-green colour, and a little tinged with red next the sun. It comes into eating in January.

The Cockles pippin, which is a handsome oval-shaped apple, below the middle size, of a russet colour, mixed with yellow and red. It keeps till April.

The corpendu, or hanging body, which is a very large apple, and has a red cast on the side towards the sun; but is pale on the other side. It takes its name from always hanging downwards; and comes into eating in September.

The Dalmahoy pippin, which is about the size of a golden pippin, of a green colour, and a little streaked with red towards the sun. It has a tolerably good flavour, rather sharp; and is in eating from September to February.

The Dimock's red, which is under the middle size, of a fine red colour, intermixed with a little yellow on the side from the sun. It is ripe in January, and keeps till March.

The Dredge's seedling, which is a fine large apple, striped with red next the sun, and of a yellowish-green on the other side. This is an excellent kitchen apple, of a pleasant taste, and keeps till the latter end of January.

The Dredge's beauty of Wilts, which is a beautiful apple, of a good size, and one of the finest yet known in point of general utility. It is of a fine bright yellow colour, spotted with red towards the sun; and has an excellent vinous flavour. It is good either for the table or baking, and keeps till March.

The Dredge's russet, which is a small apple, of a greenish-russet colour, and of a pleasant flavour. It is ripe in November, and keeps till Midsummer.

The Dredge's white lily, which is a fine apple, of an exceeding high flavour, and keeps till March.

The Dredge's fair maid of Wiltford, which is a fine middle-sized apple, of a yellowish-green colour, with some russet next the sun, of an excellent flavour. It is a great bearer, and is in eating from Christmas to Easter, being an excellent desert apple.

The Dredge's queen Charlotte, which is a beautiful middle-sized apple, of a gold colour, with red towards the sun. It is of an excellent flavour, comes into eating about Christmas, and keeps till February.

The Dredge's fame, which is a good sized apple, red towards the sun, and streaked like the Ribston pippin on the other side. It is a most excellent apple, being in eating from Easter to Midsummer.

The dumpling apple, which is a handsome apple, and rather above the middle size, flat shaped, and of a greenish-yellow colour, with some faint streaks of red. It keeps till March.

The Dutch queening, which is a large apple, somewhat resembling the cat's-head in shape. The colour is red next the sun, and green on the other side, with sometimes a little red. The fruit is fit only for the kitchen, and for making cyder. It is ripe in January, keeping till the end of March.

The Elton's yellow kernel, which is a handsome middle-sized apple, of a yellow colour. It is a good table apple, being in eating from January to March.

The English rennet, which is a handsome apple, beautifully streaked with red, but darkest towards the sun; of a tolerable flavour, but apt to grow mealy when kept too long. It keeps till the middle of May.

The embroidered apple, which is pretty large, and the stripes of red very broad, from which circumstance it takes its name. It is commonly used as a kitchen apple, becoming ripe in October.

The everlasting striped apple, which is below the middle size,

size, of a conical shape. The colour is a striped green towards the footstalk, and red towards the eye.

The fameuse, which is a pretty large apple, of a beautiful dark red, with a little yellow on the side from the sun. Its flesh is very white, and full of a rich sugary juice; coming into eating about the latter end of October. It was introduced from Canada by Mr. Barclay of Brompton.

The fenouillet, ou pomme d'anis, the fennel or anise apple, which is a middle-sized fruit, of a grey colour; the pulp is tender, and has a spicy taste, like aniseed. It becomes ripe in September and October.

The flower of Kent, which is a large handsome apple, of a yellow colour, and pretty good flavour. It keeps till the middle of April.

The fox-whelp, which is a small apple, streaked with red. It is ripe in January. It is a cyder apple.

The Franklin's golden pippin, which is a handsome middle-sized apple, of a conical shape and gold colour, beautifully marked with dark spots. The fruit has a fine aromatic flavour, and deserves the first place at the table; but it is a very shy bearer. It comes into eating about the middle of November.

The French crab, which is a large handsome apple, of a deep green colour, with a little red next the sun. It will keep all the year; is a good baking apple, and, if the summer be warm, pretty good for eating, and is a great bearer.

The French codlin, which is a pretty large apple, of a conical shape, and green colour, with red towards the sun, coming into eating in January.

The Fearn's pippin, which is of the shape and size of a nonpareil. It is of a beautiful scarlet next the sun, and of a golden yellow on the other side. It makes a fine show at table, and keeps till the latter end of February.

The French Spaniard, which is a large apple, in form of a hexagonal prism with the angles a little rounded, and of a yellowish-green colour; it is pretty good, and keeps till the latter end of April.

The French or white rennet, which is a large fruit, of a yellowish-green colour, with some grey spots. It has a sugary juice, and is good either for eating or baking.

The Gargey pippin, which is a handsome conical-shaped apple, under the middle size, of a greenish-yellow colour, with a little red towards the sun. This is a pretty good apple, and keeps till May.

The gilliflower, which is a fine handsome apple, red towards the sun, and of a yellowish-green on the other side, having a fine flavour, and keeping till the latter end of March.

The golden rennet, which is a beautiful apple, a little flattened; of a fine red colour towards the sun, and yellow on the other side. It is a good eating apple, and keeps till February.

The golden russet, which is a fine middle-sized apple, of a golden russet colour, from which it takes its name. It is a good apple, and keeps long.

The golden pearmain, which is a fine apple, above the middle size, of a fine deep red towards the sun, with a little yellow on the other side; when much exposed to the sun it is sometimes red all over.

The golden Mundi, which is a fine handsome apple, beautifully streaked with red; of a good flavour, excellent for baking, and will keep till January. It is a good sauce apple.

The golden Gloucester, which is a handsome middle-sized apple, of a flat shape, and gold colour, with red toward the sun. It is a good apple, and keeps till March.

The golden knob is a handsome though rather small apple,

of a fine gold colour, sometimes inclining to a russet. It has a pleasant flavour.

The golden pippin is well known; and the French own it to be of English origin. It is almost peculiar to this country; for there are few countries abroad where it succeeds well. It is yellow as gold; the juice is very sweet; the skin (especially where exposed to the sun) is often freckled with dark yellow spots. It is certainly the most ancient, as well as the most excellent, apple that we have. It ripens in October, and keeps through the winter. It has several sub-varieties.

The Godolphin apple, which is a very handsome large fine fruit, streaked with red on the side next the sun, and of a yellowish colour on the other side. It is in eating from the latter end of September to December.

The green dragon, which is a fine large apple, of an excellent flavour, and pale-green colour. It is rather too large for the table, and is therefore mostly used as a kitchen apple. It keeps till March.

The great or large russet, which is a middle-sized fruit, of a russet colour, with a little dark-red toward the sun. A pretty good apple, and keeps till April.

The Griddleton pippin, which is a large angular-shaped apple, of a green colour, with a little blush towards the sun. It is a baking apple, and keeps till March.

The Grumas's pippin, which is about the size and shape of a golden pippin; of a dingy-green colour next the sun, and of a dull yellow on the other side. It is ripe in January, and keeps till April.

The Hagloe crab, which is a yellow-coloured conical-shaped apple, below the middle size. It is ripe in January; but is only fit for making cyder, or for baking.

The hall-door, which is a fine large apple, of a flat shape, beautifully streaked with red toward the sun, and of a greenish-yellow on the other side. It is of a fine flavour, and is in eating from January till March.

The Hallingbury, which is a large flat-shaped apple, with large ridges from the base to the crown. It is of a beautiful red toward the sun, and of a yellowish colour on the other side and towards the eye.

The Hampshire nonfuch, which is a pretty large well-shaped apple, of a greenish-yellow colour, streaked with red. It keeps till the latter end of November.

The Harvey's russet, which is so called in Cornwall, is a large russet-coloured apple, with a little red toward the sun. It is a famous kitchen fruit, and tolerably good raw, with a musky flavour.

The Holland pippin, which is a middle-sized apple of a flattish shape. Its colour is yellow, in some places inclining to green, with, sometimes, a little red toward the sun. It is a pretty good apple, keeping till the middle of April.

The hollow-eyed pippin, which is a middle-sized apple, of a yellow colour, beautifully spotted with red toward the sun; and the eye is pretty deep. It is a good sharp-flavoured apple, keeping till the middle of May.

The hollow-eyed rennet of Cornwall, which is a handsome flat-shaped apple, under the middle size, of a greenish-yellow colour, sometimes intermixed with russet. It is of an excellent flavour, and keeps till April.

The hedge apple, which is a new fruit, of middle size and handsome conical shape, red toward the sun, and of a straw colour on the other side. It is of a tolerably good flavour, and keeps till the latter end of April.

The hoghead apple, which is a small red fruit; the flesh is red, and the taste austere. It is a cyder apple, becomes ripe in January, and keeps till March.

The Hubbard's, or the russet pearmain, which is a real Norfolk apple; and, though not handsome, is one of the best table apples. It is of a dark russet colour, becomes ripe in January, and keeps till April.

The John apple, which is a middle-sized handsome fruit, of a green colour, with a little red toward the sun; the footstalk being very small. It is an excellent cyder and baking apple, from Devonshire; it is of an excellent flavour, and keeps till March.

The Isle of Wight pippin, which is a handsome middle-sized apple, of a greenish-yellow colour.

The juneting, or jenneting, which is a small yellowish apple, red on the side next the sun. It is a pretty fruit for early variety, and ripens about the latter end of June or beginning of the following month.

The kernel redstreak, which is of a greenish-yellow, with broad streaks of a dark-red all over it, and a yellow ground finely speckled with red next the sun.

The kernel pearmain, which is a small handsome apple, red toward the sun, and of a yellowish-green mixed with red on the other side. It is of a good flavour, keeping till the middle of May.

The Kentish pippin, which is a good sized apple, finely streaked with red. It is of a fine flavour, comes into eating about Christmas, and keeps till February.

The Kentish nonpareil, which is a handsome flat-shaped apple, of a light-russet colour, inclining to red toward the sun. It is of a good flavour, and keeps till May.

The king of the pippins, which is a middle-sized apple, of a fine gold colour, a little streaked with red towards the sun. It is ripe in January, and keeps till the latter end of March, when it becomes mealy.

The king apple, which is a middle-sized apple, of a conical shape; and its colour is that of a beautiful red intermixed with a little yellow on one side. This apple is of a pleasant fragrant taste, and keeps till the latter end of April.

The Kirke's seedling, which is a beautiful apple of a fine red colour towards the base, and yellow towards the eye. The footstalk is slender, and the eye large.

The Kirke's scarlet pearmain, which is a handsome middle-sized apple, of a beautiful red toward the sun, and a little yellow on the other side; becoming ripe in January.

The Kirke's scarlet admirable, which is a good apple for baking, and of a beautiful scarlet colour, is in eating about the month of January.

The Kentish fill-basket, which is a species of codlin, of a large size, and generally used for baking. It is in eating from August to October.

The Kirton or crack'd pippin, which is a middle-sized apple, of a greenish-yellow colour, with little dark spots. The coat is generally rough towards the footstalk. It is a good apple for the table, coming into eating in September.

The lady's finger, which is an excellent table apple, of a conical shape; red next the sun, and of a yellowish cast on the other side, having a sweet pleasant flavour, and keeping till May.

The large flyre, which is a handsome cyder apple, of a yellow colour, with a little red next the sun. It becomes ripe in November.

The Lisbon pippin, which is a handsome middle-sized apple, of a flat shape, a fine red toward the sun, and a reddish-yellow on the other side. The flesh is firm, and has a sharp pleasant taste. It comes into eating in November.

The Loan's pearmain, which is a large oval-shaped apple, of a dull green colour intermixed with a brownish-red, deepest next the sun. It is a pretty good table apple, of a

sharp taste, ripening in September, and keeping till May, but is apt to grow mealy.

The London pippin, or five-crowned pippin, which is a fine large apple, of a green colour, streaked with red toward the sun. It resembles the Ribston pippin, but is larger. It has a pretty agreeable taste; and will come into eating about the latter end of November. It is good for the kitchen and table; and a most abundant bearer. It keeps till the middle of April.

The le calville d'automne, the autumn calville, which is a large fruit, of an oblong figure, and of a fine red colour toward the sun, having a vinous juice, and is much esteemed by the French.

The long latter, which is a middle-sized apple, of an angular shape, and fine yellow colour, with a beautiful red next the sun. It is of a tolerable flavour, and keeps till the middle of May, but is apt to become mealy.

The lemon pippin, which is a handsome oval-shaped apple, of a gold colour. It is of a fine flavour, and will keep till the beginning of March.

The long seam, which is a large angular-shaped baking apple of a pretty good flavour, with light green colour. It keeps till the latter end of January.

The lord Cheney's green, which is a middle-sized Yorkshire apple, resembling the Yorkshire greening. It is of a dark green colour, with a little of a chocolate colour next the sun. It is a baking apple, and keeps till the middle of May.

The lord Arundel's apple, which is large, of an angular shape; the colour is green, with a little dingy red towards the sun. It is from France, and good for sauce, keeping well.

The lord Camden's rennet, which is a good-sized seedling, of a yellow colour, with a little brownish-red next the sun. It is a good flavoured apple, and keeps till March.

The Lucas's pippin, which is a handsome, middle-sized, cylindrical-shaped apple, of a beautiful orange colour. It is a pretty good fruit, and keeps till the latter end of April.

The maiden's blush, which is a small apple, of a dark mahogany colour next the sun, but paler on the other side, and sometimes of a greenish cast. The taste is austere, and of course this fruit is not fit for the table; but does very well for baking, or for cider. It keeps till the beginning of March.

The Mansfield tart, which is a large Nottingham apple, but most known in Yorkshire. It is handsome, of a green colour, having a little cast of brownish-red, with dark spots next the sun, being a baking apple, and keeping till February.

The May gennet, which is rather under the middle size, of a greenish-yellow colour, slightly streaked with red next the sun. It keeps till April.

The major Hemmings's apple, which is a handsome middle-sized fruit, of a light green colour, with a little brownish-red towards the sun. It is an excellent apple.

The margil, which is an excellent apple, about the size of a nonpareil. It is of a red colour, with some yellow on one side; continues in use from November to the latter end of March; and is often sold in the London markets for a nonpareil.

The Margaret apple, which is a fine and beautiful fruit, yellow, striped with red, of a delicate taste, sweet scent, and generally eaten off the tree. It is ripe in August.

The Minchall crab, which is a handsome middle-sized Lancashire apple, of a yellow colour, with some brown spots.

spots. It is common in the Manchester markets, and keeps till April.

The monstrous rennet, which is a very large apple, turning red towards the sun, and of a dark green on the other side. It is generally preserved on account of its magnitude, as the flesh is apt to be mealy. It becomes ripe in October.

The mother rennet, which is rather under the middle size, of a greenish colour, with a little blush towards the sun. The eye is large and deep, and the footstalk small.

The New-England pippin, which is a large angular-shaped apple, of a green colour, with a little brownish-red towards the sun. It has a pretty good flavour, and keeps till March.

The Newton pippin, which, according to Mr. Forsyth, is an American apple, but said to be originally from Devonshire. It is a fine large apple, of a greenish-yellow colour and red, with dark spots next the sun. When much exposed, it is of a beautiful red towards the sun, and of a gold colour on the other side. It has a fine flavour when not kept till it is too ripe, as then it becomes mealy. It is in eating from November to January.

The new red must, which is a fine large apple, of a pale red towards the footstalk, and of a greenish colour towards the eye. It is a cider apple, and fit for baking.

The new red pippin, which is a beautiful middle-sized apple, of a deep red colour, with a mixture of yellow on the side from the sun. It keeps till March.

The nonfuch, which is a good bearer, and very fit either for the table or kitchen; the cooks, however, complain that it makes but a very small proportion of sauce. It is ripe in September and October.

The nine-square, which, according to Forsyth, is a Gloucestershire apple. It is a large angular-shaped fruit, of a fine red towards the sun, and yellow on the other side, with a small mixture of red, keeping till April.

The Norfolk colman, which is a middle-sized apple, of a mahogany colour towards the sun, and a dark green on the other side. It keeps till August.

The Norfolk beefin, which is a good-sized apple, rather flattened, of a deep red colour towards the eye, but paler towards the footstalk.

The Norfolk paradise, which is a large apple, of a dark red colour towards the sun, and green on the other side. It is a nice baking apple, and of a tolerable flavour for eating. It keeps till the middle of May.

The Norfolk storing, which is a pretty large apple, of a dark red colour towards the footstalk, and green towards the eye. It is of a pleasant sharp flavour, being in eating from the latter end of January to the latter end of April.

The northern greening, which is a fine oblong apple, full at the footstalk, of a pale green colour, with a little red towards the sun. It is nearly of an equal size from the base to the crown, and has a fine flavour, being ripe in January.

The nonpareil, which is a fruit deservedly valued for the briskness of its taste. It is seldom ripe before Christmas, and, if well preserved, will keep till May. It is justly esteemed one of the best apples that have been yet known.

The oak peg, or oaken pin, which is an oval-shaped middle-sized fruit, of a green colour striped with white. It is very full towards the footstalk, which is small, keeping till June.

The old English pearmain, which is an oval-shaped apple, of a middle size, and fine red colour, with a little yellow towards the eye. It is of a pleasant sweet flavour; and is in eating from January to March.

The old red must, which is a fine large apple, somewhat resembling the new red must, both in shape and colour, with the addition of dark red spots towards the footstalk.

The old red pippin, which is a middle-sized apple, red towards the sun, and of a greenish colour on the other side. It is a good apple, and keeps till March.

The orange pippin, which is about the size of a large golden pippin; of a beautiful gold colour, with a little pale red towards the sun. It is a handsome apple, of a good flavour, and makes a fine appearance at table, being in eating in October, and keeps till March, but gets flat in the taste when too long kept.

The Orleans pippin, which is a small flat-shaped apple, of a dark red colour, resembling the Orleans plum.

The paradise pippin, which is a handsome middle-sized apple, of a reddish cast. It comes into eating in October, but will not keep. It grows mealy when too ripe.

The paufon, which is below the middle size, of a conical shape, and of a greenish-yellow, or light green colour. It is ripe in January.

The Pile's russet, which is a middle-sized longish-shaped apple, russet about the footstalk, yellow towards the middle, and of a brownish-red about the eye. It is a very firm fruit, of a sharp acid flavour, being much esteemed for baking. It ripens in October, and will keep till April.

The pigeonette, which is rather below the middle size, of a conical shape. It is of a pink colour, pretty dark towards the sun.

The Pearfon's pippin, which is a nice apple, about the size of a large golden pippin, of a yellowish colour, and the form a little flat. In Devonshire, according to Mr. Forsyth, they put these pippins into the oven just after the bread is drawn, laying a weight over them to flatten them, in the same manner as they do the beefin in Norfolk, and bring them to table as a sweetmeat. It is a very good dessert-apple, and keeps till March.

The pomme grise, which is a fine apple, from Canada, of a flattish form, and russet colour, streaked beautifully with red. It ripens late, and keeps till March. It is an excellent eating apple.

The pomme d'api, which is much valued for its colour, being of a bright red. The tree is a good bearer, and the fruit is not subject to be shaken with high winds. The fruit should be suffered to hang on the tree till October or November, if the frost do not set in. It comes into eating in February and March, and keeps long; but is more admired for its beauty than its flavour, or fineness of taste.

The pomme violette, the violet apple, which is a pretty large fruit, of a pale green, striped with red towards the sun. It has a sugary juice, and a flavour of violets, from which it takes its name. It ripens in October, and continues in eating till February, or later.

The pomroy, or king's apple, which ripens nearly as soon as the juneting, and though not so beautifully covered, is larger and much better tasted. It has a sub-variety, which is a winter apple.

The pound pippin, which is a large handsome apple, of a greenish colour, and is good for baking. It becomes ripe in January.

The poor man's profit, which is a dingy coloured oval-shaped apple, below the middle size. It is raised freely from cuttings; and keeps till January.

The queening, which is from Gloucestershire, is a large apple, of irregular shape, having large ridges from the base to the crown. It is of a dark red, but deepest towards the sun. It is a good cider apple, and bakes well, keeping till the latter end of November.

The queening's kernel, which is a fine apple, above the middle size, of a deep red colour. Covered very thick with small whitish specks. It is a tolerably good apple, and keeps till the latter end of April.

The queen's pippin, which is a small handsome apple, of a yellowish-green colour, sometimes inclining to red on the side next the sun. It is a fine-flavoured apple, very fit for the table, coming into eating in January, and keeping till May, but is apt to grow mealy when kept too long. Mr. Forfyth says, "the tree never grows to the height of other apple-trees."

The quince-apple, which is a middle-sized fruit, of a yellow colour, with a little red towards the eye. It is of a pleasant sharp flavour, ripe in January, and keeps till April.

The Ramborn, which is a large fruit, of a fine red next the sun, and striped with a yellowish-green. It ripens about the middle of September.

The red pearmain, which is smaller than the pearmain in general. It is of a deep red, with a little yellow on one side. A pleasant sweet apple, and keeps till the middle of April.

The red-streak, which is a handsome middle-sized apple, beautifully streaked with red. It is a good cider apple, becoming ripe in January.

The red-streak feedling, from Longleat, which is from the Dorsetshire red-streak, is a beautiful apple, of a yellow colour, streaked with red, particularly next the sun. Forfyth says, it is sold in the Bath and Bristol markets in the latter end of September, and beginning of October. It is a pretty good apple, but does not keep long.

The red bag, which is a beautiful large Herefordshire apple, of a longish shape, streaked all over with a dark red; and is in eating about the middle of October.

The red must, which resembles the old red must in shape; but is of a dark red colour towards the sun, and yellow on the other side. It is ripe about the middle of November.

The rennette grise, which is a middle-sized fruit, of a grey colour next the sun; it is a very good juicy apple, of a quick flavour, and ripens about the latter end of October.

The red sweet, which is a small round apple, red towards the sun, and of a greenish-yellow on the other side. It is a good bearer, according to Forfyth, "and much esteemed among the country people of Cornwall, for making a kind of tart or pie, one of their dainties at Christmas." It is a pretty good table apple, and keeps till March.

The Ribston pippin, which is a fine apple, from Ribston Hall, near Knaresborough, in Yorkshire. It is a little streaked with red towards the sun, and yellow on the other side, being one of the best apples for eating and baking, and continues in use from the end of October till April. It bears very well as a dwarf, and no garden should be without it.

The Robinson's pippin, which is about the size of a golden pippin, of a green colour, and partakes of the flavour both of a golden pippin, and a nonpareil. It keeps till May.

The royal George, which is a fine large apple, of a beautiful yellow on one side, and green on the other. It is a good apple, and keeps till June; but then grows mealy.

The royal nonpareil, which is a handsome apple, of a flattish shape, with a small footstalk and fine eye. It is about the size of a common nonpareil, of a green colour, with red towards the sun. It is ripe in January, and keeps till the latter end of March.

The royal pearmain, which is a fine large apple, beau-

tifully streaked with red. It is ripe in January, and keeps till March, being a pretty good apple.

The royal russet, or leather-coat russet, which is a large fruit, and one of the best kitchen apples that we have. It is also a pleasant eating apple, and a great bearer, being in use from October to April.

The russet pippin, which is of a rough russet colour towards the sun, and of a green colour, sometimes inclining to yellow, on the other side. It is a good keeping apple, and fit either for baking or eating raw. It is ripe about the beginning of February, and keeps till March.

The summer pearmain, which is striped with red next the sun; the flesh is soft, but soon turns mealy; so that it is not much esteemed. It is in eating in August and September.

The silver pippin, which is a handsome middle-sized conical-shaped apple, of a fine yellow colour, with a faint blush towards the sun. The flesh is firm and very white, and of an excellent flavour. It keeps till the middle of May, or later.

The seek no farther, which is a handsome apple, rather above the middle size, of a pale green colour, a little streaked with red. It is of a pleasant though not very high flavour; and is in eating from January to May; but is apt to be mealy when kept longer than the beginning of April.

The Sykehouse, which is a handsome middle-sized apple, from Sykehouse in Yorkshire, of an orange colour towards the sun, sometimes inclining to red, and yellow on the other side. This is a fine eating apple; ripe in January, and keeps till April.

The stone pippin, which is of a green colour, streaked with red towards the sun. It is of a sharp taste, and is in eating from January till the middle of May.

The Stoup codlin, which is a large handsome apple, of a pale-green colour, with a little red towards the sun. It is a baking apple, of a pleasant taste, and keeps till May.

The striped nonpareil russet, which is a handsome apple, of a greenish-russet colour, with a little brownish-red towards the sun. It is about the size of a large nonpareil, is ripe in January, and keeps till March.

The spice apple, which is a handsome middle-sized angular-shaped apple, of a yellow colour, and a pleasant flavour. It is ripe in January, and keeps till March.

The Skerm's kernel, which is a conical-shaped middle-sized apple, beautifully streaked with red, deepest towards the eye, and having a good deal of yellow towards the footstalk. It is ripe in January, and keeps till March.

The spice rennet, which is a handsome apple, below the middle size, red towards the sun, and yellow on the other side.

The Spanish pearmain, which is a middle-sized oblong apple of a carnation colour, and dark-red towards the sun. It is a pretty good apple, and keeps till the beginning of May.

The Spanish onion, which is a handsome round apple of a russet colour, with a dull red towards the sun. This apple, which is rather below the middle size, is very good for desert, keeping till March.

The Sharp's russet, which is below the middle size, of a brownish-red colour towards the sun, and a pale-green on the other side. It is shaped like the frustum of a cone; is of a pretty good flavour; and keeps till May.

The Spencer's pippin, which is a middle-sized apple, of a yellowish colour, with many dark spots, being a baking apple, and keeping till the middle of May.

The Tankerton, which is a conical-shaped yellow apple, with sometimes a little blush towards the sun. It is an excellent

excellent fauce apple, and bakes well, being of an agreeable taste, but too large for the table. It will keep till February.

The transparent apple, which was introduced from St. Petersburg; but it is more curious than useful: a tree or two, therefore, will be sufficient for a garden. It ripens in September or October.

The Trevoider rennet, which is a small handsome russet-coloured apple, of an excellent flavour, and will keep till May.

The white corpendu, which is a middle-sized long-shaped apple, of a yellowish colour. It is a good eating apple, and ripens in January.

The ward apple, which is a beautiful flat-shaped apple, rather below the middle size, of a fine red towards the eye, and of a yellowish-green towards the footstalk. It is a sharp flavoured fruit, and keeps till June.

The Wheeler's russet, which is of middling size, the flesh firm, and of a quick acid flavour; it is an excellent kitchen fruit, and keeps long. It ripens in October.

The wine russet, which is a middle-sized conical-shaped apple, of a dark russet colour, and sharp flavour. It keeps till the latter end of April.

The Wheeler's extreme, which resembles the pomme grise, and is about the size of a nonpareil. It is a flat-shaped apple, beautifully clouded with red on a yellowish-russet ground; is of an excellent flavour, and keeps till April.

The white muft, which is a middle-sized handsome apple, of a greenish-yellow colour, with a little red towards the sun; the flavour is rather tart, but agreeable. It is ripe in January.

The Whitmore pippin, which is a good-sized handsome apple, streaked with red towards the sun, and of a pale-yellow on the other side. It has firm flesh, of a tolerably good flavour, and is in eating from November to the latter end of April, or later.

The Wiltshire cat's-head, which is a large handsome apple, red towards the sun, and green on the other side. It is a very fine baking apple, and of a good flavour, being ripe in January.

The winter pearmain, or Herefordshire pearmain, which is of a fine red next the sun, and striped with red on the other side; the flesh is juicy, and stewes well. It is fit for use in November, and, if properly managed, will keep till the latter end of March.

The winter pomroy, which is a pretty large conical-shaped apple, of a dark-green colour, a little streaked with red towards the sun. The coat is rather tough. It is a good baking apple, keeping till January.

The winter box apple, which is a middle-sized fruit, of a light green colour, and keeps till February.

The woodcock, which is a good-sized apple, of a dark red next the sun, and paler, with a little mixture of yellow, on the other side. It is ripe in January, and keeps till March, being a good cider apple.

The Wright's nonpareil, which is a Salopian apple, being a great bearer, of a good size, and a little flattened. It is a good kitchen apple, and keeps till June. The tree is smaller in size than most other apple-trees.

The Yorkshire greening, which is a good-sized flattened apple, of a dull-red colour, with a little green towards the eye. It keeps till August, or often later.

The sorts of apples advised for a small garden are the following: the juneting, the golden pippins, the nonsuch, the Ribiton pippin, the nonpareils, the queen's apple, the Sykehouse, the golden rennet, the aromatic pippin, the grey Leadington, the scarlet pearmain, the lemon pippin, the

pomme grise, the French crab, and different sorts of russetins and codlins, for baking.

But there are other varieties and sub-varieties that may be equally valuable with many of the above sorts.

Of the sixth sort there are the following varieties: the pear quince, with oblong-ovate leaves, and an oblong fruit lengthened at the base; the apple quince, with ovate leaves and a rounder fruit; the Portugal quince, with obovate leaves, and an oblong fruit, which is more juicy and less harsh than the others, and therefore the most valuable.

The quince is a very beautiful tree when in flower, as well as when the fruit is ripe in the autumn, and was cultivated in this country at an early period. According to Mr. Forsyth, the best sort for planting in the fruit-garden is the Portugal, being the fittest for baking or stewing. It is of a fine purple colour when dressed, and is much better for marmalade than any of the other sorts. The oblong kind, and the apple quince, are also planted in these situations, and other sorts are employed in the shrubberies for producing variety. The above sorts are likewise valuable for mixing with apples in making pies, puddings, &c. as they add a quickness to the flavour when flat.

Method of Culture in the Pear Kind.—These trees are raised by grafting and budding upon any kinds of pear stocks; occasionally upon quince stocks; and sometimes upon white-thorn stocks; but the first sort are preferable for general use to have large trees, and the second for moderate growers.

The numerous varieties of these trees having been first accidentally obtained from seed, and as these seedlings rarely produce the same sorts again, the approved kinds are continued and increased only by grafting or budding upon stocks raised from the kernels of the kinds just mentioned. In order to restrain the growth of these trees, white-thorn stocks have also been used; but these are not so generally successful, and are almost in total disuse in the nurseries: of course pear stocks are proper for general use, for principal large trees, both for walls, espaliers, and standards; and quince stocks for smaller growths. For raising the stocks, the seeds or kernels of the different sorts should be sown in the latter end of autumn, as November, or December, or early in the spring, in beds of light earth, covering them near an inch deep; they come up in the spring: and in autumn, winter, or spring following, the strongest should be planted out in nursery-rows to remain for grafting and budding, for which, after having from one to two or three years' growth, they will be of proper size.

The operations of grafting and budding should be performed in the usual method; the former in the spring, and the latter in summer. (See GRAFTING and BUDDING.) For this purpose the grafts and buds should be procured from such trees as produce the finest fruit of the respective sorts; those designed as dwarfs for walls, espaliers, or standard-dwarfs, being grafted or budded near the bottom; and in those for half or full standards, the stocks may either be previously trained up from three or four to seven or eight feet high to form a stem, then grafted near the top, or be grafted low in the stock, like the dwarfs, and the first main shoot trained for a stem the above height: the grafted trees, both dwarfs and standards, shoot the same year, but the budded ones not till the spring after; and when their heads are two years old from the grafting and budding, they may, if thought proper, be planted out for good, or remain longer in the nursery, as may be found convenient.

The dwarfs for walls, espaliers, &c. whether they remain longer in the nursery, or be transplanted at a year old into the garden, should have the first shoots from the graft or bud,

bud, when a year old, headed down in March to five or six eyes, to force out a proper supply of four, six, or more lateral branches near the ground, to furnish the wall or espalier with bearers quite from the bottom, these readily producing others to cover the upper part.

Standards, supposing them to be grafted on high stocks, may either be headed near the top of the stock, or permitted to run up, as the case may require, so that if shortened it will force out laterals near the head of the stem, and form a more spreading full head; and if suffered to run up with the first shoots entire, they form higher and generally more upright heads in the end. Such standards, however, as are grafted or budded as low in the stock as for dwarfs, must have the first shoot trained upright at full length, six or seven feet high for a stem: if for full standards, they may either be topped at six feet height, to force out laterals near that part to form a spreading head, or suffered to run and branch in its own way to form a more erect and higher head.

The headed trees, both dwarfs and standards, on being cut down in the spring, soon branch out from all the eyes immediately below; when care should be taken during the summer to trim off all shoots from the stem, suffering all the top shoots to remain entire; when they will form handsome beginning young heads by the end of summer, and in autumn, winter, or spring following, may be finally planted out into the garden, &c.

When from necessity they are retained longer in the nursery, the whole should have proper pruning to reform irregular growths, and the different trees be trained accordingly, suffering the whole to branch away at full length, not shortening any after the above general heading down, when a year old, except it should seem occasionally necessary, either to reduce any casual irregularity, or to procure a more full supply of lower branches; after which no further general shortening should be practised to these sort of trees; for, after having obtained a proper set of regular branches near the head of the stem, they readily furnish more in their turn to increase the head on the upper part.

In regard to planting out the trees, they are mostly of proper growth for this purpose when from one or two to four or five years old, from the graft or bud; but if larger trees are required, those of six or eight years old may be safely transplanted; younger trees, however, always succeed well, even when only two or three years old.

In selecting pear-trees for planting, Mr. Forsyth advises the choosing of the oldest trees that can be found instead of the young ones, and such as have strong stems; to have them carefully taken up, with as much of the roots as possible, and carefully planted, after cutting in the roots a little, spreading them as horizontally as can be done. Then to fill up all round the roots with light dry mould; forcing it in, about those which lie hollow, with a sharp-pointed stick; filling the whole up to the top without treading the mould, till the hole be first filled with as much water as it will contain, leaving it a day or two until the ground has absorbed the water; then to throw on some fresh dry mould and tread it as hard as possible, filling the hole up again with mould to within an inch of the top, and giving it a second watering, leaving the mould about three inches higher than the border, to settle of itself, and to receive the rain that falls, for at least a month. When the mould has become quite dry, it may be trodden a second time; then make a large basin all round the tree, and giving it another watering, mulching the top over with some rotten leaves or dung, continuing to water the trees once a week in dry weather, and sprinkling the tops frequently with a pot, or hand engine, to keep the wood from shrivelling till

they have taken fresh root; and where the trees are planted against a wall, the stems should stand sloping towards it; the lower parts of them being six inches from the bottom of the wall, to give them room to grow, as when planted close to the wall at bottom, the stems, in growing, will be confined on the back, grow flat, and be very unsightly. If any roots are in the way, to hinder it from being planted near enough to the wall, they must be cut off; at the same time taking care that the tree does not lean to either side, but that, when viewed in front, it appear perfectly upright. Sometimes standards and half-standards are seen planted a foot or two from the wall, which gives them a very disagreeable appearance; six inches is, he thinks, quite sufficient. Much care should be taken not to wound the stem or root of the tree in planting.

When young trees have two stems, he advises always to cut off one of them, leaving the stoutest and straightest, planting that side outwards which has most buds on it.

It is added, that when the buds begin to break well, the trees should be headed down to three or four eyes, to fill the wall with fine wood, but never afterward, except the leading shoot to fill the wall, leaving the fore-right shoots to be pruned, as hereafter directed. He has had some trees that had forty pears on them the second year; while some of the same kind bore only eleven pears the fourteenth year after planting, with the common method of pruning. When such old trees as recommended above cannot be procured, the stoutest and cleanest of the one-year's old grafting should be provided. Where any of these trees become stunted after a number of years, they should be headed down as hereafter directed, which will bring them into fresh vigour and fruitfulness. The proper season for planting them out is any time in open weather from the end of October till March, but the autumn or early winter are the most advantageous periods. They succeed well in any common garden soil, or good fertile orchard-ground, or field, that is not very wet, or of a stiff or stubborn quality, but moderately light and friable to the depth of one spade at least, and if more the better. The ground should be prepared by proper trenching one or two spades deep, as the depth of good soil will admit, wholly if for a full plantation, or only along the place for each row of trees, in the place for each tree; or only a hole for each tree at proper distances. The proper distance for planting the dwarf sorts for walls or on espaliers, is for those on free stocks at not less than twenty feet, but if twenty-five, or more, the better, especially if the walls be rather low, &c. that there may be full scope to extend their branches considerably in a horizontal direction, as they will effectually fill that space, or even much more if it be allowed them; but they are often planted much nearer together. It is however of importance to give these trees sufficient room, and the higher the walls the better, as is evident by those trees growing against the ends of high buildings, as they extend themselves very considerably every way. Some plant cherry-trees or other moderate shooting fruit-trees in the intervals for a few years, till the pears advance in growth and approach one another, when they should be removed. They are to be planted in the usual way, with their heads entire. See PLANTING.

However, for trees that are dwarfed by grafting or budding upon quince stocks, from fifteen to eighteen feet may be a proper distance for planting, either for walls or espaliers. In respect to the distance at which pear-trees should be planted against walls, it is observed by Mr. Forsyth that when they are grafted on free stocks, such as colmars, pear d'auche, crafanes, pefchafferies, virgouleuses, and winter and summer bonchrétiens, it should at least be twelve yards distant

distant from each other, supposing the walls to be from twelve to sixteen feet high; but when they are only ten feet, fifteen yards will be little enough for the purpose.

And where they are planted on south walls, vines, peaches, nectarines, or apricots, may be planted between them, till the trees extend so far as nearly to meet each other; then they may be removed to any other situation in the garden where they are wanted. And where the pears are planted on west walls, the same sort of trees may be planted between them as on south walls; the fruit on a west aspect will come into use to succeed that on the south. On an east wall different sorts of plums and cherries may be planted between the pear-trees till they almost meet, then transplanted as standards or wall trees.

It is advised that the borders for pear-trees in a large garden should not be less than from ten to twenty feet wide, with a foot-path about three feet from the wall, covered over at top with coal-ashes or road-sand, to make a dry walk for getting at the trees to cut and nail them, to gather the fruit, &c. And that the depth of the mould for them should never be less than three feet, laying the best mould at top, to encourage the roots to come as near the surface as possible. If the bottom be clay, it will be very necessary, once in every five or six years, to open the ground round the roots of the trees, and cut off all the large ones that are inclining to run into the clay; as, by this practice, the trees will throw out fresh roots that will run near the surface, provided the mould is good near the top of the borders. And it is suggested that a crop of early peas, lettuces, spinach, or any other small crops, may be grown on the borders, during the winter and spring; but no late crops by any means. If the ground can be spared, he would advise to have no summer crops, but keep the borders hoed, in particular after rain; otherwise the ground, if a strong loamy or clayey soil, will be apt to crack in dry weather; but by frequent stirring between wet and dry this will in a great measure be prevented, and the sun's rays admitted into the mould, which will greatly heighten the flavour of the fruit. When you can conveniently spare the borders in winter, they should be ridged up to sweeten the mould, which may be very well done if you sow early peas on the sides of the ridges; which is by far the best way to preserve the peas from the frost, and to prevent them from rotting, which will sometimes happen, if the land be strong, before they begin to vegetate; or, you may sow an early crop of carrots or spinach on these borders.

With respect to the general management in the training and pruning of these trees, if the young wall and espalier trees thus planted are only one year old from the graft or bud, having their first shoots of a year old entire, these should in the spring be headed down to five or six inches, to force out lower horizontal branches; but if they have been previously headed, as advised above, and have thrown out laterals to form a regular set of horizontal branches, consisting of six or more near the bottom, they should not now be shortened, but trained to the wall or espalier at full length horizontally, preserving an equal number on each side five or six inches asunder; they will readily emit a further supply of horizontal shoots to cover the wall, &c. regularly upward, and at the same time not being shortened, they gradually form themselves for bearing, as every shortening of the branches of these trees retards their bearing a year at least; if, however, there is a want of branches, some of the middlemost may be pruned short, and trained to the wall or espalier. According as the trees shoot in summer, a further supply of all the regular shoots in every part where they occur, should be trained in at full length, unless it

shall seem necessary to prune some strong shoots to obtain a greater supply of horizontal branches the same year, in order to furnish the head as soon as possible; at this time, however, displace all the fore-right and other irregular growths of the year, continuing the supply of regular shoots close to the wall, as they advance in length during their summer's growth. And in the winter pruning, the supply of shoots attained in summer should be well examined, selecting all those that are well placed and properly situated for training in, to increase the number of horizontal branches on each side, which should be left wholly entire, and at the same time retrenching any superfluities and ill-placed shoots omitted in summer; then the whole supply of regular horizontal branches in every part should be trained in straight and close to the wall or espalier, equally on both sides of the tree, every branch at the full length, at four, five, or six inches apart. See WALL, ESPALIER-Trees, and PRUNING.

But there is another method sometimes practised in training these trees for walls and espaliers, which is, that after their first heading down, and having thrown out several laterals, to select three of the strongest and most regularly placed, one on each side and one in the middle, nailing the two side ones horizontally at full length, and the middle one upright: the tree having produced a further supply of shoots in the following year, add two or four of them as side branches, arranging them on each side of the stem as the two former, training the middle shoot still in an upright direction; observing that where it does not furnish horizontals low enough, it may be shortened so as to make it throw out shoots at any requisite height, continuing the middle one always upward for a stem, and the side ones for bearers. In either of these methods of training the trees, continue yearly increasing the number of horizontal shoots, till the full space of walling or espalier is regularly covered with bearers at equal distances, constantly continuing them all at full length, as far as the scope of walling, &c. will permit; as they naturally form fruit-spurs at every eye, almost their whole length, and the same branches continue in a fruitful state a great length of time. When the trees have once filled the wall or espalier with branches, they need but very little further supply for many years, and that only occasionally, according as any worn-out or decayed branch occurs, and wants renewing with young wood. See PRUNING.

And in the after-prunings in the summer, which should be begun in May, or early in June, rub off all the superfluous and unnecessary shoots of the year, and all fore-right and other ill-placed shoots, retrenching them quite close, being careful to leave the terminating shoot of every horizontal or bearer entire; and reserving here and there a well-placed shoot, towards the lower parts in particular, and where there are any apparent vacancies, to train up between the mother branches, till winter pruning, when, if not wanted, they must be retrenched.

But in the winter pruning, which may be performed any time from the fall of the leaf until March, the branches should be generally examined, to see if they are any where too much crowded, or trained irregularly; and where any such occur, they should be regulated as they may require; and where there are any vacancies, some contiguous shoots, reserved in the summer dressing, should be laid in, and all the other shoots not wanted must be cut clean out close to the branches, being careful still to preserve the terminating shoot of every branch entire, in all parts, as far as the allotted space admits, likewise all the fruit-spurs in every part, fastening in all the branches regularly at full length. In pruning old trees at this season, where decayed and worn-out branches occur, they should be cut out, and young wood trained in

its stead; likewise, where any branch, through age or any other defect, is become barren, it should be retrenched, and some eligible lower young branch, or shoot, be laid in its place.

Where any of the choicer sorts of these trees are become worn-out and barren, they should be renewed with young bearers, by heading the branches wholly down near the bottom in winter or spring, when they break out in the old wood, and in the following summer furnish a large supply of strong young shoots, which should be trained according to the rules already laid down, when they will soon form a sort of new tree, and bear good fruit. After each winter pruning, the trees which are against walls and espaliers require a general nailing, &c. which should always be done with great regularity. See *WALL-Trees*, and *ESPALIER-Trees*.

The mode of training dwarf standard-trees of this sort is shewn in speaking of trees of that kind. See *DWARF-Trees*.

In respect to the culture of the borders where this sort of wall or espalier-trees are growing, it is commonly digging them once more every year, adding manure occasionally in common with the other parts of the garden; but if some good rotten dung be applied every other year, and the ground well dug or trenched every winter, it greatly promotes the size and perfection of the fruit. In regard to standard-trees of this kind, any of the sorts bear plentifully in any open situation, though the fruit may not always be so large and fine as those of wall and espalier-trees: summer and autumn pears, however, ripen in great perfection on standards, as also most of the common winter pears. In planting them, trees of from two or three to four or five years old, having tolerable heads, are of a proper age and size for the purpose, and are preferable to older trees for any general plantation. They should be planted with all their heads entire, except retrenching any very irregular-placed branch, in the usual manner of tree-planting. See *PLANTING*.

In their future growth they should be suffered to branch naturally, so as to form large branchy heads, suffering them all to remain entire. The general culture of this sort of trees, in respect to pruning, is very trifling, and only required occasionally, probably only once in several years; such as the retrenching any irregular growing branches, and thinning such branches as are very much crowded, cutting out all the decayed wood, and eradicating suckers from the roots and stems. See *PRUNING*.

When standard-trees are situated in a garden, in which the ground is necessarily dug over and trenched annually for the reception of the under crops, and occasionally enriched with dung, they generally produce finer fruit than in orchards, or other places where the ground is not in similar culture.

Mr. Forsyth observes, that the method of pruning pear-trees is very different from that practised for apple-trees in general, in which the constant practice has been to leave great spurs as big as a man's arm, standing out from the walls, from one foot to eighteen inches and upwards. The constant pruning inevitably brings on the canker; and by the spurs standing out so far from the wall, the blossom and fruit are liable to be much injured by the frost and blighting winds, and thus the sap will not have a free circulation all over the tree. The sap will always find its way first to the extremities of the shoots; and the spurs will only receive it in a small proportion, as it returns from the ends of the branches; and the fruit standing at so great a distance from the wall is too much exposed to the weather, and, of course, is liable to be hard, spotted, and kernelly.

The following method he has practised where the trees

were all over cankered, and the fruit small, and not fit to be sent to the table. He cut the tops off as near as possible to where they were grafted, always observing to cut as close to a joint or bud as possible. The buds are hardly perceptible, but it can always be known where the joints, or forks, are, by the branches breaking out of the sides. He adds, that finding the pear-trees in Kenington gardens in a very canker and unfruitful state in the years 1784 and 1785, he took out the old mould from the borders against the walls, and put in fresh loam in its stead; at the same time he pruned and nailed the trees in the common way, and left them in that state upwards of eighteen months, to see what effect the fresh mould would have on them; but to his great surprise he found that it had no effect. After this trial he began to consider what should be done in order to recover these old trees. In this attempt he began with cutting down four old and decayed pear-trees of different kinds, near to the place where they had been grafted: this operation was performed on the 15th of May, 1786. Finding that they put forth fine shoots, he headed down four more on the 20th of June in the same year (for by this time the former had shoots of a foot long), which did equally well, and bore some fruit in the following year. One of the first four he headed down was a St. Germain, which produced nineteen fine large well-flavoured pears next year, and in the third bore more fruit than it did in its former state when it was four times the size. He left seven trees upon an east wall, treated according to the common method of pruning, which bore the following number of pears upon each tree. Epine d'hyver produced eighty-six pears, and the tree spread fifteen yards; a crasane produced one hundred pears, and the tree spread fourteen yards; another crasane produced sixteen pears, and the tree spread ten yards; a virgouleuse produced one hundred and fifty pears, and the tree spread nine yards; a colmar produced one hundred and fifty pears, and the tree spread nine yards; another colmar produced seventy-nine pears, and the tree spread ten yards; a l'eschallerie produced sixty pears.

But seven trees headed down and pruned according to his own method, leaving the fore-right shoots in summer, bore as follows, in the fourth year after heading: a Louisonne bore four hundred and sixty-three pears, and the tree spread nine yards; another Louisonne bore three hundred and ninety-one pears, and spread eight yards; a colmar bore two hundred and thirteen pears, and spread six yards; a brown beurré bore five hundred and three pears; another brown beurré bore five hundred and fifty pears; a crasane bore five hundred and twenty pears; a virgouleuse bore five hundred and eighty pears. And he adds, that the branches of the four last trees spread nearly in the same proportion as the first three. He also states that a young beurré, the second year after heading, bore two hundred and thirty pears; and a St. Germain four hundred. All the above trees stood in the same aspect and the same wall, and the fruit was numbered in the same year. A great many pears which dropped from the trees are not reckoned. The trees that were pruned according to the old practice covered at least one-third more wall than the other.

From this statement it appears that the trees headed down bore upwards of five times the quantity of fruit that the others did; and that it keeps increasing in proportion to the progress of the trees. This is an important statement in the culture and management of old trees of this sort; and the following fact with respect to standards is deserving of great attention: On the 20th of June he headed several standards that were almost destroyed by the canker; some of them were so loaded with fruit the following year, that he

was obliged to prop the branches, to prevent their being broken down by the weight of it. In the fourth year after these standards were headed down, one of them bore two thousand eight hundred and forty pears. There were three standards on the same border with the above, two of which were St. Germain; the old tree was of the same kind. One of these trees, twenty years old, had five hundred pears on it, which was a great crop for its size: so that there were on the old tree, which had been headed down not quite four years, two thousand three hundred and forty pears more than on the tree of twenty years' growth. When the men numbered the pears, there was near a barrowful of wind-falls at the bottom of the old tree, which were not included. These and other statements are given in his useful treatise on the "Culture of Fruit-Trees."

The following is the method he pursues in training trees that are cut near to the place where they are grafted. In the month of March, every year, he shortens the leading shoot to a foot or eighteen inches, according to its strength: this shoot will, if the tree be strong, grow from five to seven feet long, in one season; and, if left to nature, would run up without throwing out side-shoots. The reason for thus shortening the leading shoot is to make it throw out side-shoots, and if it be done close to a bud, it will frequently cover the cut in one season, leaving only a cicatrix. When the shoots are very strong, he cuts the leading ones twice in one season; by this method he gets two sets of side-shoots in one year, which enable him the sooner to cover the wall. The first cutting is performed any time during the spring, and the second about the middle of June. When you prune the trees, and cut the fore-right shoots, which should be done in February or March, always cut close to an eye or bud, observing where you see the greatest number of leaves at the lower bud, and cut at them; for at the footstalk of every one of these will be produced a slower-bud. The same will hold good in cutting the superfluous shoots on standard pears. He adds, that you will have in some sorts of pears, in a favourable season, from five to nine pears in a cluster. This cutting should not be later than March, or the beginning of April, on account of the leading shoot beginning to grow: the next topping, when the leading shoot grows quick enough to admit of it, should be about the middle of June; and the length of the shoots should be according to their strength, having from three eyes or buds, to fix on a side. It is added, that the cankerous part beginning to affect the new bark, he cut off all the canker at the bottom, and plastered the place with some cow-dung, mixed with wood-ashes and powder of burnt bones, put into as much urine and soap-suds as would make it of the consistence of thick paint; this he laid on with a painter's brush. After it had been applied about three hours, he patted it gently down, with his hand, close to the tree. By so doing, he gets rid of all the air-bubbles that may be under the composition, and makes it adhere to the tree, preventing it from being washed off by heavy rains. And in the beginning of August he shortens the fore-right shoots to about four inches long; by this time the shoot will have made its full growth for the season, and will produce fine strong eyes for the following year. Such shoots as grow near the stem of the tree, if any are wanted to fill up the wall, may be tucked-in as directed for peaches. This will prevent them from looking unsightly, and save them from the fury of the autumnal and winter winds. He further advises, that whenever the trunk is hollow, it be followed under ground till you have cut out all the decayed parts and rotten roots, otherwise you will lose the tree. By proceeding according to the foregoing directions, the roots will be renewed, while the tree is forming a

fine handsome head. In the mean time the borders should be trenched, taking up all the roots, and adding some fresh mould to them, if you can conveniently get it; if you cannot, remove all the four mould that is about the roots of the trees, and put in some taken from the border, at a distance from the wall; always remembering to lay the top spit next to the roots of the trees; also, to mix some vegetable mould, from the melon and cucumber beds, with rotten leaves, as a manure for the borders. He has headed down many trees that had not this preparation; and yet they thrive very well, but did not send forth such fine roots and shoots as those that were so prepared. He concludes by observing, that if the above directions be followed, more pears will be procured in three or four years than can be done in twenty-five years by planting young trees, and pruning and managing them in the common way. It is added, that if it should be found, that, before the pears arrive at half their natural size, they get stunted, after cold blighting winds, and frosty nights, he would recommend a new operation to be performed when the weather begins to grow mild, which is to take a sharp penknife, and with the point of it make an incision through the rind of the pear from the footstalk to the eye, in the same way as in scarifying a bark-bound tree, taking care to penetrate as little into the flesh of the pear as possible. At the same time beat up some fresh cow-dung with wood-ashes, and with your fore-finger rub in a little of this composition where you made the scarification; as the wound heals, the composition will be discharged from the fruit; this will prevent the pears from cracking and bursting, which renders them good for nothing. The sorts that are most liable to this disorder are, he observes, the colmar, virgouleuse, and crasane. He only, however, recommends this operation for wall pears, as it may be thought by some a troublesome operation, and it will certainly take up some time.

Signs of Ripeness in the Fruit.—The maturity of the pear is generally known by its changing from a green to a yellow, or reddish colour, &c. and by the frequent falling from the tree; and when, with a gentle twist or turn upwards, it easily quits its hold: but these signs of ripeness are more particularly observable in summer and autumn pears; as winter pears, not being maturely ripe when gathered, often require a good pull before they quit the branches.

The summer pears ripen in succession in different sorts, from about the beginning or middle of July till the middle of September; many of the earliest ripening all at once, as it were, and continuing good but a few days, either on the tree or when gathered, nor will any of the sorts keep good long; and none of these sorts should hang on the tree till soft ripe, as in that case most of them would be mealy and insipid. These sorts should be gathered as soon as they are arrived to full growth, and just begin to colour and discover maturity, but before they become soft and mellow. For family use, they may be gathered from the tree according as they attain perfection; but the general crops of each sort should be always taken down before they ripen fully, and be laid in any dry room; none of the kinds will keep long, some only a few days, and scarcely any of them above a fortnight, though from different varieties ripening at different times, the succession is continued for eight or ten weeks.

The autumn sorts ripen in different varieties, from about the middle of September till the end of October; some of the forwardest become eatable on the tree, others requiring to lie some time after being gathered before they acquire perfection. The different sorts of these pears should be gathered according as they arrive to maturity: those designed

to keep some time, may be gathered in dry weather, just when they have attained full growth, as shewn by their frequent dropping, and by their readily quitting the trees on being handled, and laid in a dry clove room, or in baskets, each sort separately.

The winter kinds attain their full growth on the trees about the end of October or beginning of November; but the eatable kinds do not acquire maturity for that purpose on the tree, or for some considerable time after they are gathered, some probably in a month, others two or three, and some more, and some sorts not till the spring following. But the baking kinds may be used any time from October or November during their continuance. All winter pears should be indulged with as full growth on the tree as the weather will permit, even until the end of October, or first week in November, in the later kinds, if the season continues mild: be cautious, however, to get them gathered before attacked by much frost. And in gathering all the sorts for keeping, dry weather should be chosen, and when the fruit is also quite dry, being careful not to bruise them. See FRUIT.

Method of Forcing Pears.—These sorts of trees are sometimes forced by artificial heat, in some of the prime early kinds, to obtain a portion of fruit as early in the season as possible. This is effected by means of hot-walls and forcing-frames; having previously some trees of the choicest early summer pears, such as the jargonelle, or any other early sort, trained as wall-trees against a south wall, till advanced to some tolerable state of bearing; being then inclosed with glass frames, in the manner of forcing-frames or hot-walls, and having internally either flues for fire-heat, erected forward and extending long-ways, or otherwise a pit arranged in that direction, in the interval or space between the trees and the glass-work, for a bark or dung hot-bed; and by one or other of these methods a proper degree of artificial heat is produced internally to force an early growth in the trees, and forward them to early flowering and fruiting, managing them in the common way, as other trees in forcing-frames, so as to have some ripe fruit early in June, or some time in that month.

Method of Culture in the Apple Kind.—The whole of the varieties of the apple were first accidentally obtained by raising them from the kernels of the fruit; but as these cannot be depended upon to continue the same sort of fruit, grafting is the mode made use of to increase and continue the different varieties of them, which is performed upon crab, or any kind of apple stocks, raised from the kernels, for dwarfs as well as standards: and sometimes upon codlin and paradise apple stocks raised from cuttings and layers, when designed to have espaliers and other dwarf trees, or for small standards, as low as possible, to be confined within a moderate space: some sorts may also be raised by layers and cuttings, as the common codlin.

Stocks.—The method of raising the different sorts of stocks for the purpose is, in the crab and apple stocks, from the kernels of the fruit; but in the codlin and paradise stocks by cuttings and layers, to continue them with certainty of the same kinds and moderate growths. The crab and apple stocks may be raised from the kernels of any of the sorts, procuring them in autumn or winter, either from the fruit, or from such as have been pressed for verjuice and cider, clearing them from the grossest part of the pulp; then sowing them in beds of light earth, moderately thick, over the bed, or in drills, covering them about an inch deep. They come up in the spring; when, if the season prove dry, they should be watered occasionally, to forward and strengthen the growth of the plants;

and in the autumn, winter, or spring following, the largest may be planted out in nursery-rows, shortening their tap-roots a little, and placing them in lines two feet and a half asunder, to remain for grafting: after having from one to two or three years' growth, they will be fit for grafting upon, particularly for dwarfs, or even for full and half standards, if intended to form the stem from the graft, which is an eligible method for these trees; but if the stock is to form the stem, they require three or four years' growth, to rise to a proper height, seven feet for full, and four or five for half standards. The modes of grafting all the sorts is the same as for other fruit-trees, and should be performed in March, either by whip or cleft-grafting, according to the size of the stock. See GRAFTING.

Having provided proper grafts of the different sorts of apples intended to be raised, the stocks designed for dwarfs of all sorts must be grafted within six inches of the ground; and the standards may also be grafted low, one shoot from the graft being trained up for a stem, or on tall stocks, at five or six feet in height, but for low and half standards, at from two or three, to four or five feet, and lower for dwarf standards. The grafts of all the sorts shoot the same year; and, by the autumn following, the trees having formed little heads, consisting of two, three, or four shoots, may then be planted out finally where they are to remain, or be retained a year or two, or longer, in the nursery, as may be requisite, training them for the purposes intended, as dwarfs, espaliers, &c. &c., and uprights for standards, heading the dwarfs down in March following, within six inches of the graft, to force out more lateral shoots below to form a fuller head, proceeding immediately to turn them near the bottom, so as to fill the espalier, &c. equally with branches, quite from within six or eight inches of the ground, regularly upward. In the standards, those grafted low must be trained with one shoot upright, at full length, for a stem, five or six feet high at least, for full standards before it is topped; though if grafted on tall stocks of height sufficient for a stem, the shoots from the graft may either be headed to five or six eyes; or, if to form a more spreading head, remain entire, and aspire more in height, and assume a more upright growth: in all the modes of training, care should be taken to keep the stems clear from all lateral shoots, displacing all such as soon as they appear, encouraging only a proper set of branches at top to form the head. When these trees have heads from one to two or three years old from the graft, they are of a proper age for planting out; though trees of four or five years old will also succeed very well, and even those of six or eight years' growth may also be safely planted if required. The nursery-grounds are mostly furnished with all the varieties of these trees for sale, either quite young from the graft, or trained of several years' growth.

Choice of Trees.—In choosing the different kinds of trees for planting, care should be taken to have a collection of the principal varieties, both in espaliers and standards, in proportion to the extent of the ground, as the trees of the best sorts are as easily raised and cultivated as the indifferent ones, allotting a smaller portion of the summer kinds, as such as ripen from August to about the middle of September, for immediate use off the trees, as they will not keep long; a larger supply of the autumn sorts, and most of all of the winter keeping apples: observing, in the summer kinds, that it is advisable to allot a principal supply of the common codlin in small standards, as being generally both a great bearer, and the fruit the most useful of the summer apples for culinary purposes, from its young green growth

growth in June or July, till its full maturity in August and September, when it becomes also a good eating apple: and as the tree is a moderate grower, it admits of being planted in small standards closer or more abundant in a small extent of ground than most of the principal apple kinds.

In choosing apple-trees from the nursery, they should, Mr. Forsyth says, have strong, straight, and clean stems. And he advises not to suffer the dwarf trees to run higher than twelve feet, as otherwise they become naked at bottom, the fruit is liable to be blown down, and the tops broken by high winds.

The proper season for planting all the sorts of apples is, in mild weather, from the end of October till March; but when planted in autumn, or early in winter, they establish themselves more firmly before the drought of the following summer. They succeed in any common soil and open situation, except in low very moist land, in which they are apt to canker, and soon go off: in a pliable mellow loam they generally answer very well. The ground should be properly prepared, by good trenching, where the ranges of trees are to stand.

In the planting of espalier apple-trees they should be ranged at no less than eighteen or twenty feet distance; the latter especially for trees grafted on crab or apple stocks, which being free shooters, the branches readily fill that space. For the trees grafted on codlin and paradise stocks, fifteen or eighteen feet may be sufficient; though the latter, in particular, is sometimes planted only twelve or fifteen feet asunder, as being a very moderate shooter: it is, however, advisable to allow every sort full room, according to their growth, to have proper space to extend their branches always at full length. The trees should be planted with all their heads entire, only retrenching any very irregular growths, that do not range consistently with the intended form, and pruning any broken roots. Then having opened a proper hole for each tree, plant them in the usual manner, being careful to place them with their branches ranging the way of the espalier. As soon as the earth of the holes and of the roots is properly settled, all the branches should be trained in horizontally to the right and left, an equal number on each side at full length, as above.

The general culture in espalier trees thus planted and trained, as the same branches or bearers continue fruitful many years, is to continue them as long as they remain of proper growths, constantly giving them a summer and winter pruning annually, as explained above. In wall-trees also, any of the principal choice varieties of eating apples may be trained, to forward and improve the growth, beauty, and flavour of the fruit; such as jennetings, Margaret apple, golden pippins, golden rennets, pearmains, &c. or any other approved eating kinds, a tree or two of a sort, against a fourth, fourth-west, or east wall.

Standard apples, when planted in the garden, should be arranged thinly, to admit of under crops growing freely, without being shaded by their spreading branches. Full standards should be chiefly planted for the general crops, and half and dwarf standards for variety. The standards, when trained as above, should be planted out with all their heads entire, when in the kitchen garden, at thirty feet distance in the rows; and for an orchard, thirty feet distance every way. In planting, for each tree a wide hole should be opened, trimming any long straggling and broken roots, leaving all the others entire, and planting them with the usual care. As soon as planted out, every tree should be well staked to support them firmly upright, and prevent their being disturbed in rooting by winds. See ORCHARD and PLANTING.

Smaller growing standards, such as codlins, or other low standards grafted upon codlin stocks, and dwarfs upon these or paradise stocks, may, if required, be planted only at fifteen or twenty feet distance in the rows, and not less than twenty-five feet between the lines of trees; though, if there be room to allow a greater distance both ways, it will be advantageous, especially in planting in kitchen gardens, in which it would be proper to allow double that distance between the rows of trees, of the larger growths of these kinds. The standards thus planted with their heads entire, should be suffered to advance with their branches at full length, and in general take their natural growth, when they soon form numerous natural spurs in every part for bearing.

In respect to pruning these standards, little is required, only the occasional retrenching any irregular cross-placed bough, or the reducing to order any very long Rambler; or when the head is become greatly crowded and confused to thin out some of the most irregular growths, likewise all strong shoots growing upright in the middle of the head, and all dead wood, and suckers from the stem and root.

As to half and dwarf standards of these trees, they may be dispersed in different parts of the garden to cause variety, managing them as the full standards. The former on dwarf paradise stocks, being very moderate shooters, may be planted in a little compass; and are sometimes planted in pots for curiosity, to place on a table, amidst a desert, with the fruit growing on them. See DWARF-Trees.

It is observed by Mr. Forsyth, that in heading down old decayed apple-trees, for the sake of symmetry, it will be necessary to cut at the forked branch as near as can be to the upper side of the fork, cutting them in a sloping manner to carry off the wet, at the same time rounding the edges. To begin at the lower branches, cutting just above the lower fork; and proceeding upwards, cutting the rest of the branches from one to six joints, or forks, according to their strength, till you have finished cutting-in the whole head. If any of these branches should have the canker, all the infected part must be cut out. When the tree is all prepared; the composition should be immediately applied, beginning at the top of the tree, and finishing with the powder of wood-ashes and burnt bones as you descend, which will save it from being rubbed off during the operation; and the composition will prevent the sun and air from injuring the naked inner bark. A tree thus prepared, will in the course of three or four years, produce more and finer fruit than a maiden tree that has been planted upwards of twenty years.

These directions, if properly attended to, will be sufficient, it is supposed, to enable any one to bring old decayed trees into a healthy bearing state.

It is believed, that in large orchards and gardens, it may be necessary, at first, to head down only every other tree; cutting some of the branches of the rest, which are in a decayed and cankered state, and which bear no fruit. This will be preparing them to throw out new wood, and furnish the tree much sooner with bearing branches. He recommends the performing of the operation as early as possible; as by so doing the wood will be the stronger, as in May, or the two following months.

And it is added, that when the trees are become hollow, the same method should be followed as directed for plums; but by no means to cut them down unless the tops are quite decayed; observing to cut the loose rotten wood clean out of the hollow and other decayed parts, applying the composition; at the same time to open the ground, and cut out

all the rotten parts that may be found in the lower part of the stem, together with all the decayed roots, which, if this be not done, will infallibly injure the fresh wood and bark, and prevent a cure from being effected. He would recommend heading down all apple-trees that are much cankered and have ill-shaped heads; as by so doing much labour will be saved, and the trees will amply pay the proprietor. He advises never to shorten the young branches, except they are very thin, when it will be necessary to do so to fill the trees with young wood: nor prune any of the young wood: nor prune any of the young shoots the second year (he means the year after they are cut), as many of the eyes, almost to the end of the shoot, will, if it be strong, become fruit-buds next year; and so on every year. It is contended, that in the month of May in the first year after the trees have been so cut, it will be necessary to go over them, and rub off with your finger and thumb all the superfluous young shoots; leaving from three to six eyes on each shoot, according to the size and strength of the branch cut. These shoots will bear from three to four years; by which time they will be pretty much exhausted by the great quantity of fruit produced from them: they should then be cut down to two eyes to produce new wood. He always leaves three different years' branches on the tree, when the first shoot is cut off. This is fully shewn in a plate in his useful work; and the next shoot will be full of fruit-buds, if it has not been shortened: when it begins to grow weak, it should be cut off; and the next cutting must be made when the former branch is tired of bearing: by proceeding thus all over the tree with care and attention, the advantages of this method of pruning, above the common mode, will soon be perceived; as by it you will be able to keep the trees in a constant state of bearing, which, if left to nature, would only produce a crop of fruit once in two or three years. When the shoot that is done bearing is cut off, the composition should constantly be applied, rubbing off the shoots where they are too numerous.

It is supposed, that the best time to prune apple-trees is in the month of April, or in May, after the operation has been performed on the peaches, nectarines, and cherries: and that soon after this pruning, about the middle of May, it will be proper to look over the trees, and to pick off any caterpillars that may be on them. It will then be seen what shoots are infected with the canker, and which might have escaped your notice at the time of pruning; and wherever you observe the least appearance of infection, which may be known by the wood appearing of a brownish colour, the shoot must be cut down till you come to the sound white wood. The small shoots that cross each other should be cut off, leaving the strongest to fill up the tree, and make a fine handsome head. The suckers that spring from the root should be carefully grubbed up, and the side-shoots from the stem cut off; for, if left to grow, they greatly weaken the tree. The knobs, where old branches have been cut off, should also be pared away, leaving the surface of the tree as smooth as possible: after which, the composition should be applied: the young bark will soon begin to grow, and by degrees cover the old wounds with a fresh smooth surface, and thus prevent the canker from gaining ground on the tree. He has seen some old wounds of considerable size, healed over in one year: and he adds, in confirmation of the utility of this practice, that the trees which he pruned and dressed, as above directed, in the course of the summer, 1795, are all perfectly cured, the wounds being filled up with sound woody and covered over with new bark: they all continue in a healthy state, and bear fine handsome fruit. And he has advised several nurserymen to follow the practice, head-

ing down their apple-trees after the season of drawing for sale is over. Messrs. Gray and Wear have headed a great many of such trees as were formerly thrown into the faggot-pile, and have been amply recompensed for their trouble. Trees thus headed down, provided the stems be strong, will, he thinks, in the first and second year, produce as much fruit as will refund the purchase-money; besides, a great deal of time will be saved, which would be lost by planting younger trees: as, where you can procure trees of the above description that have been headed down three or more years, they will be all covered with fruit buds; and, if carefully taken up and planted in the autumn, if the season proves favourable, they will have a tolerable crop of fruit the first year. Such trees must not be headed down like maiden trees, but only thinned off where the branches run across and rub against one another, which should never be suffered in these cases. He says, he would never recommend training apple-trees as espaliers; as by doing so the air is kept from the quarters of the garden; and by constant pruning and cutting off all the side-shoots which you cannot tie to the espaliers, you prevent them from bearing, and, moreover, bring on the canker. And when the dwarf trees have handsome heads, more and much finer fruit will be gotten from one of them than from six espaliers; at the same time, a free air is admitted to the crops in the quarters, and the constant expence of the stakes and labour, in laying the trees to the espaliers is saved. Espaliers may, he observes, be converted into dwarf standards by shortening the branches at different lengths, so as that they may be able to support themselves without the stakes; but not to shorten them all regularly; and if cut with judgment, as near to a leading shoot, or an eye, as possible, they will in the course of two years form fine heads, and in the third year bear six times the fruit as they did in their former state, and of a finer flavour. The same method of pruning as already laid down for standard apple-trees is also applicable to espaliers.

It is remarked, that the borders where you make your crossings in gardens should be six or eight feet broad at least, to let the trees spread on each side, at the distance of twelve feet from tree to tree, and they should be well trenched, two feet and a half deep at least. If there should be gravel, or four clay, it must be taken out, and good mould put in its place; leaving the ground as rough as possible for the frost and rain to mellow it. When you level the ground it should be done after rain; you may then sow some small crops in the border; such as lettuce or spinach, or cabbage for transplanting; but let not any of the brassica tribe come to full growth. Leaving cabbage and broccoli on borders, near fruit-trees, draws the ground very much, fills the borders with insects, and also prevents the sun and air from penetrating into the ground. And when the sun can have free access to the border, it adds much to the flavour of the fruit. If you can spare the ground on the cross-borders in winter, it will be of great service to the trees to ridge it up as loose as you can, and let it lie in that state all winter, to mellow and sweeten.

Where the soil is strong, he would recommend planting of apple-trees that are grafted on paradise stocks; but if the soil be light, free stocks will do much better: and when the ground is strong clay or brick-earth, it should be mixed with old lime-rubbish or coal-ashes, street-dung, or sand: but what he uses for the borders against the walls, and which he prefers to every other manure, is a vegetable mould produced from leaves of trees. Of this a good coat should be given once in two or three years, which will be sufficient, he thinks, for the borders where the wall-trees stand, and much better than dung, which he by no means approves

approves of for trees, unless it be perfectly rotten and mixed up with mould.

In respect to grafting old apple-trees, he says, it frequently happens, that through some mistake or other, after waiting ten or twelve years for a tree to come into a bearing state, it is found that the fruit is neither fit for the table nor kitchen; in such cases they should always be grafted the following spring, observing to graft on the finest and healthiest shoots, and as near as possible to the old graft, and where the cross-shoots break out; as by so doing you will have some fruit the second year; and in the third, if properly managed, you will have as much as on a maiden tree of fifteen years standing; the canker, if any, must be carefully pared off the branch, and the scion must be taken from a sound healthy tree. Whenever an incision is made for budding or grafting, from that moment the canker begins. He would, therefore, recommend to those employed in budding or grafting, as soon as the incision is made, and the bud or graft inserted, to rub in with the finger, or a brush, some of the composition before the bafs is tied on: then to cover the bafs all over with the composition as thick as it can be laid on with a brush, working it well in. If this operation be performed in a proper manner, and in a moist season, it will answer every purpose without applying any grafting clay: as he has frequently done it, and found it succeed perfectly to his wishes. The matting which is wrapped round the bud should not be slackened too soon; for in that case you will find the incision opened, which very often occasions the death of the bud. If, says he, nurserymen and gardeners would give this method a fair trial, and use the same composition as he uses for curing defects in trees, instead of loam and horse-dung (which binds so hard as to prevent the rain and moisture from penetrating to the graft to moisten the wood and bark), they would find that the grafts would succeed much better. The composition, for this purpose, should be rather softer than grafting clay generally is; and instead of applying so large a mass as is generally done of clay, it need not, in most cases, be more than two or three inches in circumference, to effect the purpose.

Apples come to full growth in different sorts successively, from July until the end of October: the summer kinds continue but a short time, but the autumn and winter apples keep from two or three to six or eight months and longer, in different varieties. The signs of perfection or full growth of the different sorts of apples, are by their assuming a lively colour, emitting a fragrant odour, frequently falling from the tree, and by quitting their hold easily on being handled.

Gathering.—In the gathering of all the sorts of apples for keeping, dry weather should always be chosen, and when the trees and fruit are also perfectly dry: observe likewise, in gathering apples for the table, and all kinds of apples designed for keeping any considerable time, that they be pulled one and one by hand. See FRUIT.

The other species may be increased by grafting and budding them upon the common crab-stock: they should have sheltered situations, as they are rather tender while young. These trees afford ornament and variety in the clumps and shrubby parts of pleasure-grounds.

Method of Culture in the Quince Kind.—These trees may be raised from the kernels of the fruit sown in autumn; but there is no depending on having the same sort of good fruit from seedlings, nor will they soon become bearers. But the several varieties may be continued the same by cuttings and layers; also by suckers from such trees as grow upon their own roots, and likewise be increased by grafting and budding

upon their own pear-stocks, raised from the kernels in the same manner as for apples.

The raising by cuttings, layers, and suckers, is performed in autumn, winter, or spring, choosing young wood for the cuttings and layers, which should be planted and laid in the common method, when they will be rooted by the following autumn, then planted out into nursery rows two feet asunder; plant the suckers also at the same distance, and then train the whole for the purposes intended: if for standards, run them up with a stem to any desired height, from three to five or six feet, then encourage them to branch out at top, to form a head; and those designed as dwarfs must be headed near the ground, and trained accordingly for espaliers, or dwarf standards, as directed under those articles: the grafting or budding is effected on quince or pear-stocks, and trained as above. When they have formed tolerable heads, they should be planted out finally.

Mr. Forsyth advises that the layers or cuttings should be planted in a shady place, in rows at about a foot distant from each other, and about three inches from plant to plant in the rows; mulching them with rotten leaves, or rotten dung, which will keep the ground about them moist; and watering them frequently in hot weather. About Michaelmas those that are well rooted may be planted out, and those that are not should remain another year. They may also be propagated by budding or grafting; and these trees will bear sooner, and be more fruitful than those raised by any other method.

He observes, that the quince-tree may be pruned much in the same way as an apple-tree, taking care to cut out all the old diseased and dead wood, and the cross branches in the middle of the tree, which are apt to injure each other by friction. In general you will find old trees much hurt by injudicious pruning: in that case they should be headed down, cutting out all the cankerous parts, and also all the diseased and dead wood where the tree is hollow, or where large branches have been cut or broken off, applying the composition as for apple-trees: and as quince-trees are very apt to have rough bark, and to be bark-bound, in these cases it will be necessary to shave off the rough bark with a draw-knife, and to scarify them when bark-bound, brushing them over with the composition. It is also advised to plant quince-trees at a proper distance from apples and pears, as bees and the wind may mix the farina, and occasion the apples or pears to degenerate.

Standard quinces, designed as fruit-trees, may be stationed in the garden or orchard, and some by the sides of any water, pond, watery-ditch, &c. as they delight in moisture, suffering the whole to take their own natural growth: and as espaliers, they may be arranged in assemblage with other moderate growing trees, such as apples and pears on paradise and quince-stocks, cherries, &c. being trained as directed for apples and pears in espaliers. They may also be planted in shrubberies, either as full or low standards, and permitted to take their own way of growth. See ORCHARD.

PYSTERA, in *Ancient Geography*, an island situated on the coast of Asia Minor, over-against Smyrna. Pliny.

PYTHAGORAS, in *Biography*. See PYTHAGOREANS.

Posterity has been very liberal to this philosopher, in bestowing upon him all such inventions as others had neglected to claim, particularly in music; for there is scarcely any part of it, as a science, with which he has not been invested by his generous followers in biography.

Musical ratios have been assigned to him, with the method of determining the gravity or acuteness of sounds by the greater or less degree of velocity in the vibrations of strings; the

the addition of an eighth to the lyre (Pliny, lib. ii. cap. 2.); the harmony of the spheres (Plato); and the Greek musical notation (Boethius). His right, indeed, to some of these discoveries has been disputed by several authors, who have given them to others with as little reason, perhaps, as they had been before bestowed upon him.

But there is one discovery, relative to music, that has, at all times, been unanimously assigned to him, which, however, appears to us extremely doubtful, not only whether it was made by him, but whether, in the manner it is related, it was ever made by any one.

We are told by Nicomachus, Gaudentius, Jamblichus, Macrobius, and all their commentators, "that Pythagoras, one day meditating on the want of some rule to guide the ear, analogous to what had been used to help the other senses, chanced to pass by a blacksmith's shop, and observing that the hammers, which were four in number, sounded very harmoniously, he had them weighed, and found them to be in the proportion of 6, 8, 9, and 12. Upon this he suspended four strings, of equal length and thickness, &c. fastened weights, in the above-mentioned proportions, to each of them respectively, and found that they gave the same sounds that the hammers had done; viz. the fourth, fifth, and octave to the gravest tone; which last interval did not make part of the musical system before; for the Greeks had gone no farther than the heptachord, or seven strings, till that time." Principles and Power of Harmony, p. 8.

This is the substance of the account, as it has been lately abridged by Mr. Stillingfleet, who points out many incredible circumstances with respect to the story in general, and denies that the weights 6, 8, 9, 12, would give the intervals pretended; but seems not to have seen the least difficulty in the fact, relative to *different hammers producing different sounds upon the same anvil*. The frontispiece to M. Marpurg's History of Music, represents the Samian sage in the act of *weighing the hammers*.

But though both hammers and anvil have been swallowed by ancients and moderns, and have passed through them from one to another, with an ostrich-like digestion, upon examination and experiment it appears, that hammers of different size and weight will no more produce *different tones* upon the *same anvil*, than bows or clappers of different sizes, will from the *same string* or *bell*.

Indeed, both the hammers and anvils of antiquity must have been of a construction very different from those of our *degenerate days*, if they produced any tones that were strictly musical. Of the millions of well-organized mortals, who have passed by blacksmiths' shops, since the time of Pythagoras, we believe no one was ever detained by a *single note*, much less by an harmonious *concord*, from those Vulcanian instruments. A different kind of noise, indeed, will be produced by hammers of different weights and sizes; but it seems not to be in the power of the most subtle ear to discover the least imaginable difference with respect to gravity or acuteness. But though *different noises* may be produced from different bodies, in proportion to their size and solidity, and every room, chair, and table, in a house, has a particular tone, yet these noises can never be ascertained like musical tones, which depend upon reiterated and regular vibrations of the aliquot parts of a string, or other elastic body; and in wind instruments, upon the undulations of the air conveyed into a tube. Noise may, indeed, be *forced* from a musical string, or instrument, by violence; but noise proceeding from bodies non-elastic, or immusical, can never be *softened* into sound. M. Rousseau (Dict. de Mus. art. *Bruit*) has ingeniously imagined that noise is of the same nature as sound, with this difference, that to produce sound, the *one*

tone, with its consonant harmonics only, should be heard; such as the 8th, 12th, 15th, and 17th; whereas noise is produced by a jarring multitude of different tones, or even by one tone, when its vibrations are so violent as to render audible a considerable number of dissonant tones, of which the vibrations seldom or never coincide; such as the 7th, 9th, 11th, &c.

The long belief of this story proves that philosophers themselves have sometimes taken facts upon trust, without verifying them by experiment. And as the tone of the hammers was asserted without proof, so was the effect of their different weights fastened to strings: this Galileo discovered. The numbers 6, 8, 9, 12, applied to different lengths of strings, would, indeed, give the intervals mentioned. But it is proved, that to produce those intervals by the *tension* of different weights, the weights must be the squares of those numbers; that is, 36, 64, 81, 144. It is astonishing how the blunder had been echoed from author to author, without experiment, till the time of Galileo. And Bontempi, in trying the power of weights upon strings in the Pythagoric proportions of 6, 8, 9, 12, found, that instead of giving the 4th, 5th, and 8th of the gravest tone, they produced only the minor 3d, major 3d, and tritonus; so that the whole account falls to the ground. But though modern incredulity and experiment have robbed Pythagoras of the glory of discovering musical ratios by *accident*, he has been allowed the superior merit of arriving at them by meditation and design. At least the invention of the harmonical canon, or monochord, has been ascribed to him both by ancient and modern writers. (See MONOCHORD.) See Aristid. Quint. p. 116. Prin. and Power of Harm. Hist. des Mathem. par. Montucla. Euler, Tentamen novæ Theor. Mus. and all the writers upon harmonics and temperament.

We shall enter no deeper into this subject here, than is absolutely necessary to explain the nature of the discovery attributed to Pythagoras, to which music is indebted for the honourable appellation of *science*.

Pythagoras supposed the air to be the *vehicle* of sound, and the agitation of that element occasioned by a similar agitation in the parts of the sounding body, to be the *cause* of it. The vibrations of a string, or any other sonorous body, being communicated to the air, affected the auditory nerves with the sensation of sound; and this sound, according to him, was acute or grave, in proportion as the vibrations were quick or slow. It was also known, by experiment, that of two strings equal in every thing but length, the shorter made the quickest vibrations, and gave the acuter sound; in other words, that the number of vibrations made in the same time by two strings of different lengths, were inversely as those lengths; that is, the greater the length, the smaller the number of vibrations in any given time. By these discoveries it was that sound, considered in the vibrations that cause it, and the dimensions of the vibrating or sonorous body, was reduced to quantity, and as such, became subject to calculation, and expressible by numbers. Thus, for instance, the two sounds that form an octave are expressed by the numbers 1 and 2; which represent either the number of vibrations in a given time, or the length of the strings; and mean nothing more mysterious than that the acuter sound vibrates twice, while the graver vibrates once; or, that the string producing the lower sound is twice the length of that which gives the upper. If we consider the vibrations, the higher sound is as 2, the lower as 1: the reverse, if we consider only the lengths. In the same manner, and in the same sense, the 5th is expressed by the ratio of 2 to 3, and the 4th by that of 3 to 4.

Such was the ancient philosophy of sounds, of which Pythagoras is recorded as the first teacher. But how much of this theory was founded on experiment and demonstration, and how much of it upon hypothesis; how much of it was known, and how much taken for granted, cannot certainly be determined. The story just now discussed is too much embarrassed with absurdities and impossibilities to guide us to any probable conjecture, as to the method by which Pythagoras actually arrived at his conclusions.

The discovery, as far as it relates to the length of strings, was easily made, because it depended upon an obvious experiment. It was, likewise, easily perceived, that a short string vibrated with more velocity than a long one; but between the certainty of this general fact, and the certainty that the vibrations were in a ratio exactly the inverse of the lengths, there is a considerable gulph. (See Smith's Harmonics, sect. i. art. 7, and note f.) We have no account of the bridge upon which Pythagoras got safely over. Experiment, here, is out of the question; for the slowest vibrations that produce musical sound, are far too quick to be counted or distinguished. The inference, however, was natural, though it does not appear that the ancients were able to support it by strict and scientific proof.

Indeed it was so late as the beginning of the present century, (1714. See Phil. Trans. and Methodus incrementorum directa et inversa, by Dr. Brook Taylor,) before this ancient theory of sound was fully confirmed, and the laws of vibrations, and the whole doctrine of musical strings, established upon the solid basis of mathematical demonstration.

The second musical improvement attributed to Pythagoras, was the addition of an eighth string to the lyre, which, before his time, had only seven, and was thence called a heptachord. It is supposed by several ancient writers, that the scale of this instrument, which was that of Terpander, consisted of two conjoint tetrachords, E F G A B b C D; and that Pythagoras, by adding an eighth sound, at the top, and altering the tuning of the fifth, formed this scale: E F G A, B C D e, or a similar scale, consisting of two disjunct tetrachords.

How this scale was generated by the triple progression, or series of perfect 5ths, the abbé Rouffier has lately very well discussed, in his "Memoire sur la Musique des Anciens." We shall endeavour to explain what is meant by the triple progression in music, which is the basis of this ingenious hypothesis; referring the reader to the Memoire itself for his proofs, as inserting them here would require too much time and space for a work of this nature.

Let any sound be represented by unity, or the number 1; and as the 3d part of a string has been found to produce the 12th, or octave of the 5th above the whole string, a series of 5ths may be represented by a triple geometric progression of numbers, continually multiplied by 3, as 1 3 9 27 81 243 729; and these terms may be equally supposed to represent 12ths, or 5ths, either ascending or descending. For whether we divide by 3, or multiply by 3, the terms will be in the proportion of a 12th, or octave to the 5th, either way. The abbé Rouffier, imagining that the ancients sung their scale backwards, as we should call it, by descending, annexes to his numbers the sounds following:

Term	I	II	III	IV	V	VI	VII
	1	3	9	27	81	243	729
	B	E	A	D	G	C	F

out of which series of 5ths, by arranging the sounds in diatonic order, may be formed the heptachord, or 7th, B C D E F G A; and to these, adding the duple of the highest sound, in the proportion of 2 to 1, the abbé sup-

poses that Pythagoras acquired the octave, or proslambanomenos. This is throwing a mite into the charity-box of poor Pythagoras, without, however, telling us in what reign the obolus was coined; for we have met with no ancient author who bellows the invention of proslambanomenos upon this philosopher. The abbé does not let him or his followers stop here, but supposes an 8th term, 2187, added to the progression given above, by which a B b was obtained, which furnished the minor semitone below B b. The system of Pythagoras, according to the abbé, was bounded by this 8th term, and the principle upon which it was built being lost, the Greeks penetrated no farther into the regions of modulation, where they might have enriched their music, but contented themselves, in after-times, with transpositions of this series of sound.

The abbé Rouffier imagines, however, that though Pythagoras went no farther than the eighth term in triple progression, yet the Egyptians, in very high antiquity, extended the series to twelve terms, which would give every possible mode and genus perfect. A curious circumstance is observed by the same author, p. 28, § 47, with respect to the musical system of the Chinese, which well deserves mention here. "In collecting," says he, "what has already been advanced concerning the original formation of the Chinese system, it appears to begin precisely where the Greek left off, that is, at the VIIth term of the triple progression, which is pursued as far as the XIIth term, by which series, arranged diatonically, the Chinese acquire their scale, c b, D b, B b, A b, G b, E b, in descending: or, as Rameau expresses the same intervals, in sharps, ascending, G x, A x, C x, D x, E x, g x."—It is observable that both these scales, which are wholly without semitones, are Scottish, and correspond with the natural scale of the old simple enharmonic, given p. 34. M. Jamard, a late French writer on music, pushing calculation still further than either the Egyptians or Chinese, has obtained, by pursuing the harmonic series, 1, 2, 3, 4, &c. &c. not only the enharmonic diatonic, but even the minute intervals in the warbling of birds; it is wonderful he did not apply his ratios to human speech.

After musical ratios were discovered and reduced to numbers, they were made by Pythagoras and his followers, the type of order and just proportion in all things: hence virtue, friendship, good government, celestial motion, the human soul, and God himself, were harmony.

This discovery gave birth to various species of music, far more strange and inconceivable than chromatic and enharmonic: such as divine music, mundane music, elementary music, and many other divisions and subdivisions, upon which Zarlino, Kircher, and almost all the old writers, never fail to expatiate with wonderful complacence. It is, perhaps, equally to the credit and advantage of music and philosophy, that they have long descended from these heights, and taken their proper and separate stations upon earth: that we no longer admit of music that cannot be heard, or of philosophy that cannot be understood.

Aristides Quintilianus assures us, that music comprehends arithmetic, geometry, physics, and metaphysics, and teaches every thing, from *forming* the scale, to the nature and construction of the soul of man and the soul of the universe. To confirm this, he quotes, as a *divine saying*, a most curious account of the *end* and *business* of music, from one master Panacmus, which informs us that the province of music is not only to arrange musical sounds, and to regulate the voice, but to unite and harmonize every thing in nature. This writer, p. 102, in solving the question, whence it is that the soul is so easily affected by instrumental music, acquaints us, in the Pythagorean way, how the soul, frisking about, and playing

playing all kinds of tricks in the purer regions of space, approaches by degrees to our gross atmosphere; gets a taller for matter and solidity, and at length acquires a warm and comfortable body to cover her nakedness. Here she picks up nerves and arteries; there membranes; here spirit or breath; and all in a most extraordinary manner; especially the arteries and nerves: for what should they be made of, but the *circles* and *lines* of the spheres, in which the soul gets entangled in her passage, like a fly in a spider's web. Thus, continues he, the body becomes similar in its texture to instruments of the wind and stringed kind. The nerves and arteries are strings, and at the same time they are pipes filled with wind. "What wonder, then," says Arillides Quintilianus, "if the soul, being thus intimately connected with a body similar in construction to those instruments, should sympathize with their motions."

Master Thomas Mace, author of a most delectable book, called "Musick's Monument," would have been an excellent Pythagorean; for he maintains that the mystery of the Trinity is perspicuously made plain by the connection of the three harmonical concords, 1, 3, 5; that music and divinity are nearly allied; and that the contemplation of concord and discord, of the nature of the octave and unison, will so strengthen a man's faith, "that he shall never after degenerate into that *gross sub-heavenly sin* of atheism." P. 268.

Pythagoras is said, by the writers of his life, to have regarded music as something celestial and divine, and to have had such an opinion of its power over the human affections, that, according to the Egyptian system, he ordered his disciples to be waked every morning, and lulled to sleep every night, by sweet sounds. He likewise considered it as greatly conducive to health, and made use of it in disorders of the body, as well as in those of the mind. His biographers and secretaries even pretend to tell us what kind of music he applied upon these occasions. Grave and solemn, we may be certain; and vocal, say they, was preferred to instrumental, and the lyre to the flute, not only for its decency and gravity, but because instruction could be conveyed to the mind, by means of articulation in singing, at the same time as the ear was delighted by sweet sounds. This was said to have been the opinion of Minerva. In very high antiquity mankind gave human wisdom to their gods, and afterwards took it from them, to bestow it on mortals.

In perusing the list of illustrious men, who have sprung from the school of Pythagoras, it appears that the love and cultivation of music was to much a part of their discipline, that almost every one of them left a treatise behind him upon the subject.

PYTHAGORAS's *Table*. See TABLE.

PYTHAGOREA, in *Botany*, received that appellation from Loureiro, in memory of the famous Pythagoras, who is said to have written a book on the qualities of plants.—Loureir. Cochinch. 243. Class and order, *Oëandrie Tetragynia*. Nat. Ord.

Gen. Ch. *Cal.* Perianth inferior, bell-shaped, of seven or eight linear, hairy, coloured leaves. *Cor.* superior, bell-shaped, of seven or eight lanceolate, concave, hairy petals, the length of the calyx. *Stam.* Filaments eight, awl-shaped, longer than the corolla; anthers roundish, two-lobed. *Pist.* Germen between the calyx and corolla, nearly ovate, hairy; styles four, awl-shaped, reflexed, shorter than the stamens; stigmas acute. *Peric.* Capsule ovate, of four cells. *Seeds* numerous, roundish.

Eff. Ch. Calyx of seven or eight leaves, inferior. Corolla of seven or eight petals, superior. Capsule of four cells, with many seeds.

1. *P. cochinchinensis*.—Native of Cochinchina, where it is

called *Xuong cá tiá nbo lá*. A small tree, with numerous branches. *Leaves* nearly sessile, ovato-lanceolate, serrated, smooth; their longitudinal ribs red at the extremity. *Clusters* axillary, long, nearly simple, with short partial stalks. *Flowers* white.

Such is Loureiro's account, but we have no knowledge of the plant he describes, nor can we offer any conjecture respecting its natural affinity. We have no faith in the existence of a germen superior to the calyx and inferior to the corolla, the only instance of the kind which Linnæus ever imagined, in *Sanguiforba*, proving not well founded.

PYTHAGOREAN, or PYTHAGORIC *System*, among the *Ancients*, was the same with the Copernican system among the moderns. See SYSTEM.

It was thus called, as having been maintained and cultivated by Pythagoras, and his followers; not that it was invented by him, for it was much older.

PYTHAGOREANS, a sect of ancient philosophers, who adhered to the doctrine of Pythagoras.

Pythagoras, the founder of this sect, was of Samos, the son of a lapidary, and a pupil of Pherecydes, and flourished (says Bayle) about five hundred years before Christ, in the time of Tarquin, the last king of Rome, and not in Numa's time, as many authors have supposed. See Cicero *Tuscul. Quest. lib. iv. cap. 1*.

The time of his birth, however, has been much disputed. Dr. Bentley, in his "Dissertation on the Epistles of Phalaris," relying chiefly on the authority of Eratosthenes, refers the birth of Pythagoras to the 4th year of the 43d olympiad, B.C. 608. Lloyd, in his "Dissertation concerning the Chronology of Pythagoras," ascribes his birth to the 3d year of the 48th olympiad, B.C. 586. Dodwell places it in the 4th year of the 52d olympiad, B.C. 569, resting in this date chiefly on the authority of Porphyry and Jamblichus. Upon the whole, the opinion of Lloyd seems to be the most probable, which is, that he was born about the year B.C. 586, and that he died about the 3d year of the 68th olympiad, B.C. 506; so that it seems pretty certain, that he was not born earlier than the 4th year of the 43d olympiad, B.C. 605, nor later than the 4th year of the 52d, B.C. 569. If we admit only the credible particulars of his childhood and early education, and pay no attention to the tales of Jamblichus and others, who even asserted that he was the son of God, we shall find that he was first instructed in his own country by Cresphilus, and afterwards by Pherecydes, in the island of Scyrus, and that after having paid his last tribute of respect to his preceptor, he returned to Samos, and pursued his studies under the direction of his first master. Jamblichus, and other later biographers, mention his journey into Ionia, and his interviews with Thales and Anaximander, but of this journey we have no authentic record, nor is any effect of it discernible in his doctrine, which is essentially different from that of the Ionic school. His first journey from the Grecian islands was probably into Egypt, which was celebrated in his time for that kind of wisdom which best suited his genius and temper. In his way thither, Jamblichus asserts that he visited Phœnicia, and conversed with the prophets and philosophers that were the successors of Moyses the Physiologist; which Moyses, Selden, and some others, will have to be Moses.

Nor is it thought at all improbable that Pythagoras might wish to acquaint himself with the Phœnician philosophy, of which he must, without doubt, have received a general report from his father, and from other merchants who traded to this coast. But that he derived his knowledge of numbers from the Phœnicians is not at all probable, because their acquaintance with numbers extended no further than

to the practical science of arithmetic. It has been said, indeed, that Pythagoras travelled, not only into Egypt and Chaldæa, but even into the Indies, to inform his understanding with regard to all branches of science and prevalent customs; and that after returning to his own country, being unable to bear the tyranny of Polycrates, he retired into the eastern part of Italy, then called Magna Græcia, and established his sect, denominated from this circumstance the "Italic Sect," or "Italic school." Whatever opinion is entertained of this journey to the East, to which Le Clerc gives no credit, we must altogether reject other stories of his visiting the temple on mount Carmel, and remaining there for several days, without food, passing among the inhabitants for a good dæmon, and obtaining from them religious honours; and of his proceeding into India, and there passing through several ceremonies of the Mosaic law.

Pythagoras, whilst he was in Egypt, was introduced by the recommendation of Polycrates, tyrant of Samos, to Amasis, king of Egypt, a distinguished patron of literary men, and thus obtained access to the colleges of the priests. Having found it difficult to gain this privilege, he performed many severe and troublesome preliminary ceremonies, and even submitted to circumcision, a prescribed condition of his admission. He passed twenty-two years in Egypt, availing himself of all possible means of information with regard to the recondite doctrines of the Egyptian priests, as well as their astronomy and geometry, and Egyptian learning in its most unlimited extent.

Many writers of reputation, both Pagan and Christian, who flourished after the commencement of the Christian era, relate, that after Pythagoras had left Egypt, he visited the Persian and Chaldæan Magi, and proceeded so far as to have intercourse with the Indian Gymnosophists. Jamblichus asserts, that he was taken captive by the victorious army of Cambyfes, and carried to Babylon, where he acquainted himself with the learning and philosophy of the East; and that after the expiration of twelve years, when he was in the 60th year of his age, he returned to Samos. The circumstance of his having visited the Persian magi is also mentioned by Cicero, Eusebius, Lactantius, and Valerius Maximus, though they take no notice of his captivity. In this journey to the East, as some have maintained, he attended upon the instructions of the celebrated Persian sage, Zoroaster; and others, who have placed the life of Zoroaster in an earlier period than that of Pythagoras, have asserted, that he conversed with certain Jewish prophets, who were at that time in Babylon, in a state of captivity, and thus became acquainted with the Jewish laws and customs. However, several objections, particularly of a chronological kind, have been alleged against the narrative of Pythagoras's journey to the East. Chronologists unanimously agree, that Cambyfes invaded Egypt in the fifth year of his reign, or the third year of the 63d olympiad. According to Jamblichus, Pythagoras, after staying twelve years in Babylon, and visiting several other countries, went into Italy in the 62d olympiad. The same date is affixed to this journey by Diodorus and Clemens Alexandrinus; whilst others place it about fourteen years earlier. Hence it appears, that if Pythagoras left the East before the 62d olympiad, after remaining there twelve years, he could not have been carried thither by Cambyfes in the 63d olympiad. Moreover, the whole narration of Pythagoras's journey into the East is contradicted by the express authority of Antiphon (quoted by Porphyry), who says that Pythagoras, after his residence in Egypt, returned into Ionia, and opened a school in his own country; and that, at the age of forty years, finding himself harassed by the tyranny of Polycrates, he withdrew

into Italy; and according to this account, we have no interval for the supposed eastern expedition. The reality of this expedition is testified either by certain Alexandrian Platonists, who were desirous of exalting, as much as possible, the wisdom of those ancient philosophers, whom they considered as the oracles of wisdom, or by certain Jewish and Christian writers, who were disposed to credit every tale which tended to give probability to the opinion that the Pythagorean doctrine was derived from the Oriental philosophers, and ultimately from the Hebrew scriptures. In either case the authenticity of the relation is liable to just suspicion; nor is there any probable argument to prove, that Pythagoras received instruction from any prophet of the Hebrew nation, during his supposed residence at Babylon. Brucker concurs with those writers who are disposed to reject this story of Pythagoras's eastern journey as a mere fiction, and who concludes that, having never passed from Egypt to the East, he returned thence immediately to Samos. The story of his having visited the northern Druids is so destitute of probability and of evidence, as to merit no regard.

After his return from Egypt to his native island, he wished to communicate the benefit of his twenty years' researches and studies to his fellow-citizens, and with this view he attempted to institute a school for their instruction in the elements of science; proposing to adopt the Egyptian mode of teaching, and to communicate his doctrines under a symbolical form: but the Samians were either too stupid or too indolent to profit by his instructions. Although he was obliged to relinquish his design, he did not altogether abandon it. In order to engage the attention of his countrymen by some other means, he repaired to Delos; and after presenting an offering of cakes to Apollo, he there received, or pretended to receive, moral dogmas from the priests, which he afterwards delivered to his disciples under the character of divine precepts. With the same views he also visited the island of Crete, so celebrated in mythological history; where he was conducted by the Corybantes, or priests of Cybele, into the cave of mount Ida, in which Jupiter is said to have been buried. Here he conversed with Epimenides, an eminent pretender to prophetic powers, and was by him initiated into the most sacred mysteries of Greece. About the same time he visited Sparta and Elis, and was present during the celebration of the Olympic games, where he is said to have exhibited a golden thigh to Abaris, in order to convince him that he was Apollo. Besides other places which he visited during his stay in Greece, he repaired to Phlius, where he first assumed the appellation of philosopher. (See PHILOSOPHER.) Having thus added to the stores of learning which he had previously accumulated, and acquired a kind of authority which was calculated to command respect, he returned to Samos, and made a second attempt, more successful than his first, for establishing a school of philosophy. In a semicircular kind of building, which the Samians had used as a place of resort for public business, he delivered with an assumed authority of a sacred nature, popular precepts of morality; and he also provided for himself a secret cave, into which he retired with his intimate friends and professed disciples, and here he gave his followers daily instructions, accompanied with a considerable parade of mystery, in the more abstruse parts of philosophy. His fame, and the multitude of his followers, increased. What he failed to accomplish by the mere force of learning and ability, he effected by concealing his doctrines under the veil of mysterious symbols, and issuing forth his precepts as responses from a divine oracle. About the beginning of the 59th olympiad, Pythagoras, desirous of escaping

the tyrannical government exercised in his native island by Syloson, the brother of Polycrates, left Samos, and, as we have already hinted, passed over into Italy, and attempted to establish his school among the colonies of Magna Græcia. It is probable that, in order to obtain credit with the populace, he about this time pretended to possess a power of performing miracles, and practised many arts of imposture. The first place at which he arrived in Italy was Crotona, a city in the bay of Tarentum, the inhabitants of which were very corrupt in their manners. But such were his reputation and influence, that he was treated with great respect, and people of all classes assembled to hear his discourses; inasmuch that the manners of the citizens were soon totally changed from great luxury and licentiousness to strict sobriety and frugality. It is said that 600 (some say 2000), persons were prevailed upon to submit to the strict discipline which he required, and to throw their effects into a common stock for the benefit of the whole fraternity. The influence of his philosophy extended from Crotona to many other cities of Magna Græcia, and obtained for Pythagoras from his followers a degree of respect little short of adoration. If he had contented himself with delivering doctrines of philosophy and precepts of practical wisdom, he might probably have continued his labours, without molestation, to the end of his life. But he manifested a strong propensity towards political innovations; and he employed his influence in urging the people to the strenuous assertion of their rights, against the encroachments of their tyrannical governors. This course of conduct raised against him a very powerful opposition, which he was unable to resist and contend against, and which obliged him to retire to Metapontum. Here he found himself still surrounded with enemies, and was under a necessity of seeking an asylum in the temple of the Muses, where, not being supplied by his friends with sufficient food, he perished with hunger. The time of his death is uncertain; but according to the Chronicon of Eusebius, he died in the third year of the 68th olympiad, B. C. 506, after having lived, according to the most probable statement of his birth, to the age of 80 years. After his death his followers paid a superstitious respect to his memory. They erected statues in honour of him, converted his house at Crotona into a temple of Ceres, the street in which it stood was called the Museum, and appealed to him as a divinity, swearing by his name.

It appears, from the history of this philosopher, that with all his talents and learning, he owed much of his celebrity and authority to imposture. His whole manner of life confirms this opinion. Clothed in a long white robe, with a flowing beard, and, as some say, with a golden crown on his head, he preserved among the people, and in the presence of his disciples, a commanding gravity and majesty of aspect. He resorted to music for promoting the tranquillity of his mind, frequently singing, for this purpose, hymns of Thales, Hesiod, and Homer. He had such an entire command over himself, that he was never seen to express, in his countenance, grief, joy, or anger. He refrained from animal food, and confined himself to a frugal vegetable diet, excluding from his simple bill of fare, for mystical reasons, pulse or beans. By this artificial demeanour, Pythagoras appeared among the vulgar as a being of an order superior to the common condition of humanity, and persuaded them that he had received his doctrine from heaven. Pythagoras married Theano of Crotona, or, as some say, of Crete, by whom he had two sons, Telauges and Mnearchus, who, after his death, took the charge of his school. Whether this philosopher left behind him any

writings has been a subject of dispute. Many works have been enumerated under his name by Laertius, Jamblichus, and Pliny; but it is the declared opinion of Plutarch, Josephus, Lucian, and others, that there were no genuine works of Pythagoras extant; and it appears highly probable, from the pains which he took to confine his doctrine to his own school during his life, that he never committed his philosophical system to writing, and that the pieces to which his name was affixed at an early period, were written by some of his followers, upon the principles imbibed in his school. The famous golden verses attributed to Pythagoras, and illustrated with a commentary by Hierocles, were not written by our philosopher, but are to be ascribed to Epicharmus, or Empedocles. They may, however, be considered as a brief summary of his popular doctrines.

His "Method of instruction," formed upon the Egyptian model, was "exoteric," and "esoteric," that is, public and private. Those auditors, who attended his public lectures, did not properly belong to his school; but followed their usual mode of living. His select disciples, called his companions and friends, were such as submitted to a peculiar plan of discipline, and were admitted, by a long course of instruction, into all the mysteries of his *esoteric* doctrine.

Previously to the admission of any person into this fraternity, Pythagoras examined his features and external appearance; inquired how he had been accustomed to behave towards his parents and friends; marked his manner of laughing, conversing, and keeping silence; and observed what passions he was most inclined to indulge; with what kind of company he chose to associate; how he passed his leisure moments; and what incidents appeared to excite in him the strongest emotions of joy or sorrow. Nor after this examination was any one admitted into his society, till he was fully persuaded of the docility of his disposition, the gentleness of his manners, his power of retaining in silence what he was taught, and, in fine, his capacity of becoming a true philosopher. After the first probationary admission, the fortitude and self-command of the candidate were put to the trial by a long course of severe abstinence and rigorous exercise. The course of abstinence and self-denial comprehended food and drink, and clothing, all which were of the most plain and simple kind; and the exercises prescribed were such as could not be performed without pain and fatigue. To teach them humility and industry, he exposed them, for three years, to a continued course of contradiction, ridicule, and contempt, among their fellows. In order to restrain the powerful passion of avarice, he required his disciples to submit to voluntary poverty; he deprived them of all command over their own property, by casting the possessions of each individual into a common stock, to be distributed by proper officers, as occasion required. After this sequestration of their goods, they lived together on the footing of perfect equality, and sat down together daily at a common table. If any one afterwards repented of the connection, he was at liberty to depart, and might reclaim, from the general fund, his whole contribution. That his disciples might acquire a habit of entire docility, Pythagoras enjoined upon them, from their first admission, a long term of silence, called *ερεμωσις*. This initiatory silence, which probably consisted in refraining from speech, not only during the hours of instruction, but through the whole term of initiation, continued from two to five years, according to the propensity discovered by the pupil towards conceit and loquacity. With regard to himself, this was a judicious expedient, as it checked impertinent curiosity, and prevented every inconvenience of contradiction. Accordingly his disciples silenced all doubts and refuted all objections,

jections, by appealing to his authority. *Αυτός ἐπε, ipse dixit*, decided every dispute. Moreover, during the years of initiation, the disciples were prohibited from seeing their master, or hearing his lectures, except from behind a curtain, or receiving instruction from some inferior preceptor.

To the members of the esoteric school (who were called *γνησίοι μαθηταί*, genuine disciples) belonged the peculiar privilege of receiving a full explanation of the whole doctrine of Pythagoras, which was delivered to others in brief precepts and dogmas, under the concealment of symbols. Disciples of this class were permitted to take minutes of their master's lectures, in writing, as well as to propose questions, and offer remarks, upon every subject of discourse. These were particularly distinguished by the appellation of the "Pythagoreans;" they were also called "Mathematicians," from the studies upon which they entered immediately after their initiation. After having made a sufficient progress in geometrical science, they proceeded to the study of nature, the investigation of primary principles, and the knowledge of God. Those who pursued these sublime speculations were called "Theorists," and those who devoted themselves more particularly to theology, were styled *σεβαστικοί*, religious. Others, according to their abilities and inclinations, were engaged in the study of morals, economics, and policy; and were afterwards employed in managing the affairs of the fraternity, or sent into the cities of Greece, to instruct them in the principles of government, or assist them in the institution of laws.

The brethren of the Pythagorean college at Crotona, called *κοινοβίοι*, *coenobium*, about 600 in number, lived together as in one family, with their wives and children; and the whole business of the society was conducted with the most perfect regularity. Every day commenced with deliberation upon the manner in which it should be spent; and concluded with a retrospect of the events that had occurred, and of the business that had been transacted. They rose before the sun, that they might pay him homage; after which they repeated select verses from Homer and other poets, and made use of music, both vocal and instrumental, to enliven their spirits and fit them for the business of the day. They then employed several hours in the study of science. These were succeeded by an interval of leisure, which was commonly spent in a solitary walk for the purpose of contemplation. The next portion of the day was allotted to conversation. The hour immediately before dinner was filled up with various kinds of athletic exercises. Their dinner consisted chiefly of bread, honey, and water; for after they were perfectly initiated, they wholly denied themselves the use of wine. The remainder of the day was devoted to civil and domestic affairs, conversation, bathing, and religious ceremonies.

The "exoteric" disciples of Pythagoras were taught, after the Egyptian manner, by images and symbols, obscure and almost unintelligible to those who were not initiated into the mysteries of the school; and those who were admitted to this privilege were under the strictest obligation of silence with regard to the recondite doctrines of their master. The wisdom of Pythagoras, that it might not pass into the ears of the vulgar, was committed chiefly to memory; and when they found it necessary to make use of writing, they took care not to suffer their minutes to pass beyond the limits of the school.

Clemens observes, that the two orders above described corresponded very exactly to those among the Hebrews; for in the schools of the prophets there were two classes, *viz.* the sons of the prophets, who were the scholars; and

the doctors or masters, who were also called *perfecti*: and among the Levites, the novices or tyros, who had their quinquennial exercises, by way of preparation. Lastly, even among the profelytes there were two orders; *exoterici*, or profelytes of the gate; and *intrinseci* or *perfecti*, profelytes of the covenant. He adds, it is highly probable, that Pythagoras himself had been a profelyte of the gate, if not of the covenant.

Gale endeavours to prove, that Pythagoras borrowed his philosophy from that of the Jews; to this end producing the authorities of many of the fathers, and ancient authors; and even pointing out the tracks and footsteps of Moses in several parts of Pythagoras's doctrine.

After the dissolution of the assembly of Pythagoras's disciples by the faction of Cylo, a man of wealth and distinction at Crotona, it was thought necessary by Lyfis and Archippus, in order to preserve the Pythagorean doctrine from oblivion, to reduce it to a systematic summary; at the same time, however, strongly enjoining their children to preserve these memoirs secret, and to transmit them in confidence to their posterity. From this time books began to multiply among the followers of Pythagoras, till at length, in the time of Plato, Philolaus exposed the Pythagorean records to sale, and Archytas of Tarentum gave Plato a copy of his commentaries upon the aphorisms and precepts of his master. Of the imperfect records of the Pythagorean philosophy left by Lyfis, Archytas, and others, nothing has escaped the wreck of time, except perhaps fundry fragments collected by the diligence of Stobæus, concerning the authenticity of which there are some grounds for suspicion; and which, if admitted as genuine, will only exhibit an imperfect view of the moral and political doctrine of Pythagoras under the disguise of symbolical and enigmatical language. The strict injunction of secrecy, which was given by oath to the initiated Pythagoreans, has effectually prevented any original records of their doctrine concerning Nature and God from passing down to posterity. On this head we are to rely entirely for information, and indeed concerning the whole doctrine of Pythagoras, upon Plato and his followers. Plato himself, while he enriched his system with stores from the magazine of Pythagoras, accommodated the Pythagorean doctrines, as he also did those of his master Socrates, to his own system, and thus gave an imperfect, and, we may suppose, in many particulars, a false representation of the doctrines of the Samian philosopher. It was farther corrupted by the followers of Plato, even in the old academy, and afterwards in the Alexandrian school. To which we may add, that the doctrine of Pythagoras itself, probably in its original state, and certainly in every form under which it has been transmitted to us, was observed, not only by symbolical, but by mathematical language, which is rather adapted to perplex than to illustrate metaphysical conceptions. In this fault Pythagoras was afterwards imitated by Plato, Aristotle, and others.

We extract from Brucker the following faint delineation of the Pythagorean philosophy: The end of philosophy is to free the mind from those incumbrances, which hinder its progress towards perfection, and to raise it to the contemplation of immutable truth, and the knowledge of divine and spiritual objects. This effect must be produced by easy steps, lest the mind, hitherto conversant only with sensible things, should revolt at the change. The first step towards wisdom is the study of mathematics, a science which contemplates objects that lie in the middle way between corporeal and incorporeal beings, and as it were on the confines of both, and which most advantageously inures the mind to

contemplation. The whole course of mathematical science may be divided into four parts: two respecting numbers, and two respecting magnitude. Number may be considered either abstractedly in itself, or as applied to some object. The former science is arithmetic; of the latter kind is music. Magnitude may be considered as at rest, or as in motion; the science which treats of the former is geometry, that which treats of the latter is astronomy.

Arithmetic is the noblest science; numbers the first object of study, and a perfect acquaintance with numbers the highest good. Numbers are either scientific or intelligible.

Scientific number is the production of the powers involved in unity, or the progression of multitude from the monad or unity, and its return to the same. *Unity* and *one* are to be distinguished from each other; the former being an abstract conception, the latter belonging to things capable of being numbered. Number is not infinite, but is the source of that infinite divisibility into equal parts, which is the property of all bodies.

Intelligible numbers are those which subsist in the divine mind before all things, from which every thing hath received its form, and which always remain immutably the same. It is the model, or archetype, after which the world, in all its parts, is framed. Numbers are the cause of essence to beings: *τὸ ἀριθμητικὸν αἰτία ἐστὶν τῆς οὐσίας.*

The monad, or unity, is that quantity, which, being deprived of all number, remains fixed; whence called monad, from *τὸ μένειν*. It is the fountain of all number. The duad is imperfect and passive, and the cause of increase and division. The triad, composed of the monad and duad, partakes of the nature of both. The tetrad, tetractys, or quaternion number, is the most perfect. The decad, which is the sum of the four former, comprehends all arithmetical and musical proportions.

According to some writers, the monad denotes the active principle in nature, or God; the duad, the passive principle, or matter; the triad, the world formed by the union of the two former; and the tetractys, the perfection of nature. Some have understood by this mysterious number, the four elements; others, the four faculties of the human mind; others, the four cardinal virtues; and others have been so absurd as to suppose that Pythagoras made use of this number to express the name of God, in reference to the word *יהוה*, by which that name is expressed in the Hebrew language. But every attempt to unfold this mystery has hitherto been unsuccessful.

The most probable explanation of the Pythagoric doctrine of numbers is, that they were used as symbolical or emblematical representations of the first principles and forms of nature, and particularly of those eternal and immutable essences, to which Plato afterwards gave the appellation of ideas. Not being able, or not chusing, to explain in simple language the abstract notions of principles and forms, Pythagoras seems to have made use of numbers, as geometers make use of diagrams, to assist the conceptions of scholars. More particularly, conceiving some analogy between numbers and the intelligent forms which subsist in the divine mind, he made the former a symbol of the latter. As numbers proceed from unity, or the monad, as a simple root, whence they branch out into various combinations, and assume new properties in their progress, so he conceived the different forms of nature to recede, at different distances, from their common source, the pure and simple essence of deity, and at every degree of distance to assume certain properties in some measure analogous to those of number; and hence he concluded, that the origin of things,

their emanation from the first being, and their subsequent progression through various orders, if not capable of a perfectly clear explanation, might, however, be illustrated by symbols and resemblances borrowed from numbers.

Next to numbers, music had the chief place in the preparatory exercises of the Pythagorean school, by means of which the mind was to be raised above the dominion of the passions, and inured to contemplation. Pythagoras considered music, not only as an art to be judged of by the ear, but as a science to be reduced to mathematical principles and proportions. We have introduced, under the article PYTHAGORAS, the manner in which he is said to have discovered the musical chords, but shall here subjoin a more minute account. As Pythagoras was one day reflecting upon the subject, happening to pass by a smith's forge, where several men were successively striking with their hammers a piece of heated iron upon an anvil, he remarked, that all the sounds produced by their strokes were harmonious except one. The sounds, which he observed to be chords, were the octave, the fifth, and the third; but that sound which he perceived to lie between the third and the fifth he found to be discordant. Going into the work-shop, he observed, that the diversity of sounds arose, not from the form of the hammers, nor from the force with which they were struck, nor from the position of the iron, but merely from the difference of weight in the hammers. Taking, therefore, the exact weight of the several hammers, he went home, and suspended four strings of the same substance, length, and thickness, and twisted in the same degree, and hung a weight at the lower end of each, respectively equal to the weight of the hammers: upon striking the strings, he found, that the musical chords of the strings corresponded with those of the hammers. Hence it is said, that he proceeded to form a musical scale, and to construct stringed instruments. His scale was, after his death, engraved in brass, and preserved in the temple of Juno at Samos.

Pythagoras conceived that the celestial spheres in which the planets move, striking upon the æther through which they pass, must produce a sound; and that this sound must vary, according to the diversity of their magnitude, velocity, and relative distance. Taking it for granted, that every thing respecting the heavenly bodies is adjusted with perfect regularity, he further imagined, that all the circumstances necessary to render the sounds produced by their motion harmonious, were fixed in such exact proportions, that the most perfect harmony is produced by their revolutions. This fanciful doctrine respecting the music of the spheres gave rise to the names which Pythagoras applied to musical tones. The last note in the musical octave he called *hypate*, because he supposed the sphere of Saturn, the highest planet, to give the deepest tone; and the highest note he called *nete*, from the sphere of the moon, which being the lowest, or nearest the earth, he imagined, produced the shrillest sound. In like manner of the rest. It was said of Pythagoras by his followers, who hesitated at no assertion, however improbable, which might seem to exalt their master's fame, that he was the only mortal so far favoured by the gods as to be permitted to hear the celestial music of the spheres. Pythagoras applied music to the cure of diseases both bodily and mental. It was, as we have seen, the custom of his school, to compose their minds for rest in the evening, and to prepare themselves for action in the morning, by suitable airs, which they performed upon the lute, or other stringed instruments. The music was, however, always accompanied with verse, so that it may be doubted, whether the effect was to be ascribed more to the musician

or to the poet. It is said of Clinius, a Pythagorean, that whenever he perceived himself inclined to anger, spleen, or other restless passions, he took up his lute, and that it never failed to restore the tranquillity of his mind. Of Pythagoras himself it is related, that he checked a young man, who, in the midst of his revels, was meditating some act of Bacchanalian madness, by ordering the musician, who had inflamed his passions by Phrygian airs, to change the music on a sudden into the slow and solemn Doric mood. If the stories which are related by the ancients concerning the wonderful effects of their music are to be credited, we must acknowledge we are strangers to the method by which these effects were produced.

Besides arithmetic and music, Pythagoras cultivated geometry, which he had learned in Egypt; but he greatly improved it, by investigating many new theorems, and by digesting its principles, in an order more perfectly systematical than had before been done. Several Grecians, about the time of Pythagoras, applied themselves to mathematical learning, particularly Thales in Ionia. But Pythagoras seems to have done more than any other philosopher of this period towards reducing geometry to a regular science. His definition of a point is, a monad or unity with position. He taught that a geometrical point corresponds to unity in arithmetic, a line to two, a superficies to three, a solid to four. Of the geometrical theorems ascribed to Pythagoras, the following are the principal: that the interior angles of every triangle are together equal to two right angles; that the only polygons which will fill up the whole space about a given point, are the equilateral triangle, the square, and the hexagon; the first to be taken six times, the second four times, and the third three times; and that, in rectangular triangles, the square of the side which subtends the right angle is equal to the two squares of the sides which contain the right angle. Upon the invention of this latter proposition (Euclid, l. i. prop. 47.), Plutarch says, that Pythagoras offered an ox, others, an hecatomb, to the gods. But this story is thought by Cicero inconsistent with the institutions of Pythagoras, which, as he supposes, did not admit of animal sacrifices. Pythagoras inferred the stature of Hercules from the length of the Olympic course, which measured six hundred of his feet. Observing how much shorter a course six hundred times the length of the foot of an ordinary-sized man was than the Olympic course, he inferred, by the law of proportion, the length of Hercules's foot; whence the usual proportion of the length of the foot to the height of a man enabled him to determine the problem. Pythagoras also applied geometrical ideas as symbolical expressions of bodies, and of natural principles; but nothing certain, or intelligible, is preserved on this head.

On astronomy, the doctrine of Pythagoras, or, however, of the ancient Pythagoreans, was as follows:

The term heaven either denotes the sphere of the fixed stars, or the whole space between the fixed stars and the moon, or the whole world, including both the celestial spheres and the earth. There are ten celestial spheres, nine of which are visible to us; namely, that of the fixed stars, those of the seven planets, and that of the earth; the tenth is the antichthon, or an invisible sphere opposite to the earth, which is necessary to complete the harmony of nature, as the decad is the completion of numerical harmony. And this antichthon may be the cause of the greater number of the eclipses of the sun than of the moon. Fire holds the middle place in the universe; or, in the midst of the four elements is placed the fiery globe of unity; the earth is not without motion, nor situated in the centre of the spheres,

but is one of those planets which make their revolution about the sphere of fire. The revolution of Saturn is completed in thirty years, that of Jupiter in twenty, that of Mars in two, that of the Sun, and of Mercury and Venus, in one year. The distance of the several celestial spheres from the earth correspond to the proportion of notes in the musical scale. The moon and other planetary globes are habitable. The earth is a globe, which admits of antipodes.

From several of these particulars respecting the astronomical doctrine of Pythagoras, it has been inferred, that he was possessed of the true idea of the solar system, which was revived by Copernicus, and has since been fully established by Newton.

From this preparatory study the disciples of the Pythagorean school were conducted to the knowledge of natural, theological, and moral science. Concerning wisdom, in general, Pythagoras taught, that it is the science which is conversant with those objects, which are in their nature immutable, eternal, and incorruptible, and therefore alone can properly be said to exist. The man who applies himself to this kind of study is a philosopher. The end of philosophy is, that the human mind may, by such contemplation, be assimilated to the divine, and at length be qualified to join the assembly of the gods. In the pursuit of wisdom, the utmost care must be taken to raise the mind above the dominion of the passions, and the influence of sensible objects, and to disengage it from all corporeal impressions, that it may be inured to converse with itself, and to contemplate things spiritual and divine. For this purpose the assistance of God, and of good demons, must be invoked by prayer. Philosophy, as it is conversant with speculative truth, or with the rules of human conduct, is either theoretical or practical. Practical philosophy is only to be studied so far as may be necessary for the purposes of life; theoretical philosophy is the perfection of wisdom. Contemplative wisdom cannot be completely attained, without a total abstraction from the ordinary affairs of life, and a perfect tranquillity and freedom of mind. Hence the necessity of instituting a society, separated from the world, for the purpose of contemplation and study.

Active or moral philosophy, which prescribes rules and precepts for the conduct of life, according to Aristotle, was first taught by Pythagoras, and after his death by Socrates. Among the moral maxims and precepts ascribed to Pythagoras are the following:

Virtue is divided into two branches, private and public. Private virtue respects education, silence, abstinence from animal food, fortitude, sobriety, and prudence. The powers of the mind are reason and passion; and when the latter is preserved in subjection to the former, virtue is prevalent. Young persons should be inured to subjection, that they may always find it easy to submit to the authority of reason. Let them be conducted into the best course of life, and habit will soon render it the most pleasant. Silence is better than idle words. A wise man will prepare himself for every thing which is not in his own power. Do what you judge to be right, whatever the vulgar may think of you; if you despise their praise, despise also their censure. It is inconsistent with fortitude to relinquish the station appointed by the Supreme Lord, before we obtain his permission. Sobriety is the strength of the soul, for it preserves its reason unclouded by passion. No man ought to be esteemed free, who has not the perfect command of himself. Drunkenness is a temporary phrensy. That which is good and becoming is rather to be pursued, than that which is pleasant. The desire of superfluity is foolish, because it knows

no limits. All animal pleasures should rather be postponed, than enjoyed before their time; and should only be enjoyed according to nature, and with sobriety. Much forethought and discretion is necessary in the production and education of children. Wisdom and virtue are our best defence; every other guard is weak and unstable. It requires much wisdom to give right names to things.

Concerning public virtue, the doctrine of Pythagoras, as it is transmitted to the present time, respects conversation, friendship, religious worship, reverence to the dead, and legislation. Upon these heads he is said to have taught thus:

Conversation should be adapted to the characters and condition of the persons with whom we converse: that discourse and behaviour, which might be proper among young persons, may be exceedingly improper between the young and aged. Propriety and seasonableness are the first things to be regarded in conversation. In all society, a due regard must be had to subordination. Respect is due to a worthy stranger, sometimes in preference even to countrymen or relations. It is better that those who converse with you should respect you, than that they should fear you; for respect produces admiration, but fear produces hatred. It is an evident proof of a good education, to be able to endure the want of it in others. Between friends, the utmost care should be taken to avoid contention, which can only be done by shunning as much as possible all occasions of strife, suppressing resentment, and exercising mutual forbearance. Reproof and correction are useful and becoming from the elder to the younger; especially when they are accompanied, on the part of the reprover, with evident tokens of affection.

Mutual confidence is never for a moment to be interrupted between friends, whether in jest or earnest; for nothing can heal the wounds which are made by deceit. A friend must never be forsaken in adversity, nor for any infirmity in human nature, excepting only invincible obstinacy and depravity. Before we abandon a friend, we should endeavour, by actions as well as words, to reclaim him. True friendship is a kind of union which is immortal.

The design and object of all moral precepts is to lead men to the imitation of God. Since the Deity directs all things, every good thing is to be sought for from him alone; and nothing is to be done which is contrary to his pleasure. Whilst we are performing divine rites, piety should dwell in the mind. The gods are to be worshipped not under such images as represent the forms of men, but by such symbols as are suitable to their nature, by simple lustrations and offerings, and with purity of heart. Gods and heroes are to be worshipped with different degrees of homage, according to their nature. Oaths are in no case to be violated.

The bodies of the dead are not to be burned. Next to gods and demons, the highest reverence is due to parents and legislators; and the laws and customs of our country are to be religiously observed.—Thus much concerning the active or moral philosophy of Pythagoras.

Theoretical philosophy, which treats of nature and its origin, was the highest object of study of the Pythagorean school, and included all those profound mysteries, which those, who have been ambitious to report what Pythagoras said behind the curtain, have endeavoured to unfold. Upon this subject, nothing can be advanced with certainty, especially respecting theology, the doctrine of which, Pythagoras, after the manner of the Egyptian priests, was peculiarly careful to hide under the veil of symbols, probably through fear of disturbing the popular superstitions. The

ancients have not, however, left us without some grounds of conjecture.

With respect to God, Pythagoras appears to have taught, that he is the Universal Mind, diffused through all things, the source of all animal life, the proper and intrinsic cause of all motion, in substance similar to light, in nature like truth, the first principle of the universe, incapable of pain, invisible, incorruptible; and only to be comprehended by the mind.

Cicero (*Nat. Deor.* l. 1. c. 12.) asserts, that Pythagoras conceived God to be a soul pervading all nature, of which every human soul is a portion: and this doctrine was perfectly consonant to the opinions received in the countries which Pythagoras visited, and where he learned theology. Justin Martyr (*Orat. ad Gentes*) expressly ranks Pythagoras among the theistical philosophers. "If any one," says he, "wishes to be informed more accurately concerning the doctrine of Pythagoras with respect to one God, let him hear his opinion, for he says, God is one: he is not, as some conjecture, exterior to the world, but, in himself entire, pervades the universal sphere, superintends all productions, is the support of all nature, eternal, the source of all power, the first simple principle of all things, the origin of celestial light, the father of all, the mind and animating principle of the universe, the first mover of all the spheres." From a variety of passages that might be cited, we may reasonably infer, that Pythagoras conceived the Deity to be the informing soul of the world, animating it in a manner similar to that in which the human soul animates the body.

Subordinate to the Deity, it was taught in the Italic school, that there are three orders of intelligence, gods, demons, heroes, who are distinguished by their respective degrees of excellence and dignity, and by the nature of the homage which is due to them; gods being to be preferred in honour to demi-gods or demons, and demons to heroes or men. These three orders, in the Pythagorean system, were emanations, at different degrees of proximity, from the supreme intelligence, the particles of subtle ether assuming a grosser clothing the farther they receded from the fountain. The third order, or heroes, were supposed to be invested with a subtle material clothing. Hierocles defines a hero to be a rational mind united with a luminous body. If to these three species we add a fourth, the human mind, we have the whole scale of divine emanation, as it was conceived by this sect of philosophers. All these they imagined to proceed from God, as the first source of intelligence, and to have received from him a pure, simple, immutable nature. God, being himself one, and the origin of all diversity, they represented him under the notion of monad, and subordinate intelligences, as numbers derived and included in unity. Thus the numbers or derived intelligences of Pythagoras agree with the ideas of Plato, except, perhaps, that the latter were of a nature perfectly spiritual, but the former were clothed with a subtle ethereal body.

The region of the air was supposed by the Pythagoreans to be full of spirits, demons, or heroes, who cause sickness or health to man or beast, and communicate, at their pleasure, by means of dreams, and other instruments of divination, the knowledge of future events. That Pythagoras himself held this opinion cannot be doubted, if it be true, as his biographers relate, that he professed to cure diseases by incantations. It is probable that he derived it from the Egyptians, among whom it was believed that many diseases were caused by demoniacal possessions.

The material world, according to Pythagoras, was produced by the energy of the divine intelligence. It is an animated sphere, beyond which is a perfect vacuum. It contains

contains spheres, which revolve with musical harmony. The atmosphere of the earth is a gross, immutable, and morbid mass; but the air, or ether, which surrounds it is pure, healthful, serene, perpetually moving, the region of all divine and immortal natures. The sun, moon, and stars, are inhabited by portions of the divinity, or gods. The sun is a spherical body. Its eclipses are caused by the passing of the moon between it and the earth; those of the moon by the intervention of the *antichthon*, before explained. The moon is inhabited by dæmons. Comets are stars, which are not always seen, but rise at stated periods.

Concerning man, the Pythagoreans taught, that, consisting of an elementary nature, and a divine or rational principle, he is a microcosm, or compendium of the universe; that his soul is a self-moving principle, composed of two parts, the rational, which is a portion of the soul of the world, seated in the brain, and the irrational, which includes the passions, and is seated in the heart; that man participates in both these with the brutes, which, from the temperament of their body, and their want of the power of speech, are incapable of acting rationally; that the sensitive soul, *ψυχή*, perishes, but the rational mind, *λογη*, is immortal, because the source whence it is derived is immortal; that after the rational mind is freed from the chains of the body, it assumes an ethereal vehicle, and passes into the regions of the dead, where it remains till it is sent back to this world, to be the inhabitant of some other body, brutal or human; and that after suffering successive purgations, when it is sufficiently purified, it is received among the gods, and returns to the eternal source from which it first proceeded.

The doctrine of the Pythagoreans, respecting the nature of brute animals, and *μετεμψυχώσεις*, the transmigration of souls, were the foundation of their abstinence from animal food, and of the exclusion of animal sacrifices from their religious ceremonies. The latter doctrine is thus beautifully represented by Ovid, who introduces Pythagoras as saying:

“Morte carent animæ: semperque priore relicta
Sede, novis domibus habitant, vivuntque receptæ.
Omnia mutantur; nihil interit; errat et illinc,
Huc venit, hinc illuc, et quoslibet occupet artus
Spiritus, eque feris humana in corpora transit,
Inque feras noster: nec tempore deperit ullo,
Utque novis fragilis signatur cera figuris,
Nec manet ut fuerat, nec formas servat eadem,
Sed tamen ipsa eadem est, animam sic semper eandem,
Esse, sed in varias doceo migrare figuras.”

“What then is death, but ancient matter dress’d
In some new figure, and a varied vest:
Thus all things are but alter’d, nothing dies;
And here and there th’ unbodied spirit flies,
By time, or force, or sickness dispossest,
And lodges where it lights, in man or beast;
Or hunts without, till ready limbs it find,
And actuates those according to their kind;
From tenement to tenement is tost,
The soul is still the same, the figure only lost:
And as the soften’d wax new seals receives,
This face assumes, and that impression leaves;
Now call’d by one, now by another name,
The form is only chang’d, the wax is still the same;
So death, thus call’d, can but the form deface,
Th’ immortal soul flies out in empty space,
To seek her fortune in some other place.”

DRYDEN.

This doctrine Pythagoras probably learned in Egypt, where it was commonly taught. Nor is there any sufficient reason for understanding it, as some have done, symbolically.

Among the symbols of Pythagoras, recited by Jamblichus and others, are the following: Adore the sound of the whispering wind. Stir not the fire with a sword. Turn aside from an edged tool. Pass not over a balance. Setting out on a journey, turn not back, for the furies will return with you. Breed nothing that hath crooked talons. Receive not a swallow into your house. Look not in a mirror by the light of a candle. At a sacrifice, pare not your nails. Eat not the heart, or brain. Taste not that which hath fallen from the table. Break not bread. Sleep not at noon. When it thunders, touch the earth. Pluck not a crown. Roast not that which has been boiled. Sail not on the ground. Plant not a palm. Breed a cock, but do not sacrifice it, for it is sacred to the sun and moon. Plant mallows in thy garden, but eat them not. Abstain from beans.

The precept prohibiting the use of beans, is one of the mysteries which the ancient Pythagoreans never disclosed, and which modern ingenuity has in vain attempted to discover. Its meaning was probably rather dietetic, than physical, or moral. But enough of these enigmatical trifles. Pythagorean precepts of more value are such as these: Discourse not of Pythagorean doctrines without light. Above all things govern your tongue. Engrave not the image of God in a ring. Quit not your station without the command of your general. Remember that the paths of virtue and of vice resemble the letter Y. To this symbol Persius refers, when he says,

“Et tibi quæ Samios diduxit litera ramos,
Surgentem dextro monstravit limite collem.”

“There has the Samian Y’s instructive make
Pointed the road thy doubtful foot should take;
There warn’d thy raw and yet unpractis’d youth,
To tread the rising right-hand path of truth.”

Brucker’s Hist. Philos. by Enfield, vol. i. b. 2. c. 12.

After the death of Pythagoras, the care and education of his children, and the charge of his school, devolved upon Aristæus of Crotonia, who, having taught the doctrine of Pythagoras 39 years, was succeeded by Mnearchus, the son of Pythagoras. Pythagorean schools were afterwards conducted in Heracleia by Clinias and Philolaus; at Metapontum by Theorides and Eurytus; and at Tarentum by Archytas, who is said to have been the eighth in succession from Pythagoras. The first person who divulged the Pythagorean doctrine was Philolaus; see his article.

PYTHAGORIC ABACUS. See ABACUS and TABLE.

PYTHAGORIC *Scôl*, or *Italic School*. See PYTHAGOREANS.

PYTHAGORIC *Tetractys*. See TETRACTYS.

PYTHAGORIC *Theorem*, or *Proposition*, is the 47th of the first book of Euclid. See TRIANGLE and HYPOTHENUSE.

PYTHEAS, in *Biography*, an ancient mathematician, astronomer, and geographer, was a native of the Greek colony of Marseilles, in Gaul, and flourished in the time of Aristotle and Alexander the Great. He contributed to the improvement of science by accounts which he wrote of his travels and voyages, and other works. To him is attributed a book, entitled *γῆς περίοδοι*, or the circuit of the earth; and in the abridgement of Artemidorus the Ephesian, he is placed in the number of those who have written a

“Periplos

"Periplus of the World;" and he is supposed to have written a treatise "De Oceano;" none of these pieces have reached modern times, though some of them were extant in the fourth century. From fragments collected out of Strabo, it appears that Pytheas introduced into them, as the testimony of others, a number of marvellous and incredible circumstances, which drew on him the censure of that author and Polybius. The last named author maintained it to be utterly impossible for a private person, who was even in want, to have travelled so far as he pretended to have done by sea and land. He, however, probably visited all the countries of Europe that are situated upon the ocean, discovered the island of Thule, or Iceland, and penetrated a considerable distance into the Baltic. This fact has been proved by Gassendi, who shews, that Pytheas was well acquainted with the northern countries, and accurately marked the distinction of climates, by the difference which he observed in the length of the days and nights in different latitudes. He also attempts to prove that Eratosthenes and Hipparchus improved their geographical works by availing themselves of the labours of Pytheas, without due acknowledgments of their obligations. There is no doubt that Pytheas was a skilful observer of the heavens, for he taught that there is no star in the precise situation of the pole, and he rendered himself famous among astronomers, by being the first calculator of the meridian altitude of the sun at the summer solstice at Marseilles. This fact he ascertained by erecting a gnomon of a given height, and finding the proportion between that height and the length of the meridian shadow. The result was found to correspond exactly with that of an observation made by Gassendi, at the same place, in the year 1636. To obviate such objections as that advanced by Polybius against the reality of Pytheas' voyages, it has been said, that he probably was furnished with the means of prosecuting them at the public expence. For as the republic of Marseilles was then powerful at sea, largely engaged in commercial pursuits, and sent Euthymenes to make such discoveries in the southern parts of the world, as might lead to the extension of its trade, it seems very probable, that Pytheas was dispatched on the public account into the northern regions for the same purposes.

PYTHEUM, in *Ancient Geography*, a town of Macedonia, in the country of the Pelasgiotes. Ptolemy places it between Azorium and Gonnus.

PYTHIA, or **PYTHIAN**, in *Antiquity*, the priestess of Apollo, by whom he delivered oracles. See **DELPHOS**.

She was thus called from the god himself, who was entitled *Apollo Pythius*, from his slaying the serpent Python; or, as others will have it, ἀπο τῆ πυθισθαι, because Apollo, the sun, is the cause of rottenness; or because the carcase of Python was left there to putrefy; or, according to others, from πυθίζομαι, *I enquire*, because people went to hear and consult his oracles.

This priestess was to be a pure virgin. She sat on the covercle, or lid, of a brazen vessel, mounted on a tripod; before she ascended which, after fasting three days, she used to wash her whole body, and especially her hair, in Castalia, a fountain at the foot of Parnassus, where the poets, men inspired by the same deity, used to wash, and drink; and thence, after shaking the laurel-tree that grew by it, and sometimes eating the leaves, which were supposed to conduce to inspiration, and were succeeded by a violent enthusiasm, she delivered her oracles, or rather explained those of the god; i. e. she rehearsed a few ambiguous and obscure verses, which were taken for oracles. The oracle being pronounced, she was taken down from the tripod and

conducted back to her cell, where she continued for several days, to recover herself from the violent agitation and conflict. Lucan informs us, that speedy death was frequently the consequence of her enthusiasm. See **ORACLE**.

Diodorus Siculus (lib. xvi.) informs us, that these priestesses were at first virgins, but that after one of them was deslowered by Echeerates, a Thessalian, choice was made of women above fifty years of age; that so they might either be secured from the attempts of lust, or if they should at any time be forced to the violation of their chastity, having passed the time of child-bearing, they might remain undiscovered, and not bring the oracles or religion into contempt; nevertheless they wore the habit of virgins, thereby to signify their purity and virginal modesty.

All the Pythiæ did not seem to have had the same talent at poetry, or to have memory enough to retain their lesson.

Plutarch and Strabo make mention of poets, who were kept in pay, as interpreters of Jupiter, &c.

PYTHIA, or **PYTHIAN Games**, were solemn games instituted in honour of Apollo, and in memory of his killing the serpent Python with his arrows.

The Pythia were celebrated in Macedonia, in a place called *Pythium*. They were next in fame after the Olympic games, but were more ancient than they; for it is pretended they were instituted immediately after the defeat of the serpent. The Pythia were also celebrated at Delphi; and they were these that were the most renowned. Their first founder, and the precise time of their institution, are not known.

The Pythian games, according to Pausanias, were first instituted by Jason or Diomedes, king of Etolia, and restored by Eurylochus of Thessaly, in the third year of the 48th olympiad, or the year of the world 3364, and 584 years before the birth of Christ; from which time the Greeks reckoned sometimes by Pythiades, as they had been accustomed to do by Olympiads. They were at first celebrated every eight years, but afterwards every four years, in the third year of each olympiad; so that the pythiade, which was a term of four years, served as an epocha for the inhabitants of Delphi. At first they consisted of poetical and musical contests, but in process of time they consisted of the other exercises of the pancratium, which were performed in the Olympic games. The victors were crowned with branches of laurel; though, at the first institution, the crown was of beech-leaves. The Romans are said to have adopted these games in the year U.C. 642, and to have given them the name of Apollinares ludi.

A part of Pindar's poems was composed in praise of the victors in the Pythian games. See **GAMES**.

The critics are divided on the subject of the serpent Python. The poets say, that Juno made use of it to persecute Latona, and prevent her bringing into the world Apollo and Diana, whom she had conceived of Jupiter; and that it was for this reason that Apollo afterwards killed it.

Strabo says, it was no other than a famous villain, one Draco, that Apollo freed the world from. Dickinson, in his "Delphi Phœnicizantes," maintains the Python of the Greeks to be the Typhon of the Phœnicians; and the Typhon of the Phœnicians to be the Og of Scripture; and Apollo, who slew it, he will have to be Joshua. See **TYPHON**.

PYTHON, in *Ancient Geography*, a name anciently given to the city of Delphi.

PYTHOPOLIS, a town of Asia Minor, in Bithynia, on the river Soloonte, according to Plutarch, founded by Theseus.

Theseus.—Also, a town of Asia Minor, in Caria; afterwards called Nissa.—Also, a town of Asiatic Myfia.

PYULCON, from *πυον*, *pus*, and *ἔλκεν*, *to draw*, an old surgical instrument anciently employed for drawing the matter out of sinuses.

PYURIA, in *Medicine*, from *πυον*, *pus*, and *ουρον*, *urine*, a term used by Sauvages and others to denote all purulent and mucous discharges from the bladder. See **CATARRHUS Vesicæ**.

PYXIDANTHERA, in *Botany*, from *πυξις*, *a box*, and *ανθηρα*, *an anther*, because, according to Michaux, each cell of the anthers opens by a sort of lid; see **DIAPENSIÆ**, to which genus the plant in question is referred by Mr. Pursh, in his *Fl. Amer. Sept.* v. 1. 148, under the name of *D. cuncifolia*, after Mr. Salisbury.

PYXIS NAUTICA, in *Navigation*, the seaman's compass.

The word *πυξις* literally signifies *a box*.

PYXIS, among *Anatomists*, is also used for the cavity of the hip-bone. See **ACETABULUM**.

PYXIS, a small metal case for containing the consecrated species in the Catholic church. Anciently it was made in the form of a dove and suspended over the altar.

PYXUS, in *Ancient Geography*, a small river of Italy, in Lucania; which took its rise northward towards Sontia, and running southward discharged itself into a gulf of the same name, E. of Pyxus, or Pyxuntum.

PYXUS, or **PYXUNTUM**, *Poli-Castro*, a town of Italy, belonging to Lucania, situated at the bottom of a small gulf, E. of a small river of the same name. It was founded by Mirathus, prince of Zanele and Rhegium, in the year 471 B.C. It became a Roman colony in the year 194 before the same era.

PYXUS Promontorium, a small cape of Italy, E. of a peninsula of Laconia, which had on the W. the promontory Palinurum. This promontory is found at the entrance of a small gulf of the same name.

PZINENIN, in *Geography*, a town of Bohemia, in the circle of Boleslau; 12 miles E. of Jung-Buntzel.

Q.

Q, A consonant, borrowed from the Latin or French, for which the Saxons generally used *cp*, *cw*; and the sixteenth letter of the alphabet.

The name of this letter is *cue*, from *queue*, Fr. *tail*; its form being that of an O with a tail.

The Q has this peculiar to it, that it is always followed by an U, and is therefore reckoned among the mutes.

The Q is formed from the Hebrew, *ק*, *kaph*; which most other languages have borrowed; though some of them have rejected it again, particularly the Greeks, who now only retain it as a numeral character, called *κοττα επισημος*.

In effect, there is that resemblance between the Q and the C, in some languages, and the K in others, that many grammarians, in imitation of the Greeks, banish the Q as a superfluous letter. Papias even asserts, that all the Latin words now wrote with a Q, were written among the ancient Romans with a C; but we want better authorities for this. For, though that may hold in many cases, inasmuch that some write indifferently *quur*, or *cur*; *cum*, or *quum*; *quotidie*, or *cotidie*, &c. yet it does not thence follow, that they ever wrote *cis*, *cæ*, *cid*, for *quis*, *quæ*, *quid*. What inscriptions authorize such a reading?

Far from this, the ancients sometimes substituted Q for C; and wrote *quojus*, *quoi*; for *cujus*, *cui*, &c.

Varro, however, and some other grammarians, as we are told by Censorinus, &c. would never use the Q. The truth is, its use or disuse seems to have been so little settled, and agreed on, that the poets used the Q or C indifferently, as best suited their measures; it being a rule, that the Q joined the two following vowels into one syllable; and that the C imported them to be divided.

Hence it is, that Lucretius uses *cuiet* for three syllables, in lieu of *quiet*; *acua*, for *aqua*; and that Plautus uses *relicuum*, for *reliquum*; as in *quod dedi, datum non vellem reliquum*

non; where the *cum* must be two syllables, otherwise the trochiac verse will be lame of a foot.

In the French, the sound of the Q and K are so near akin, that some of their nicest authors think the former might be spared. Ramus adds, that, till the establishment of royal professors in the university of Paris, under Francis I. they always used Q in the Latin the same as in the French; pronouncing *kis*, *kalis*, *kantus*, &c. for *quis*, *qualis*, *quantus*. See K.

Some very learned men make Q a double letter, as well as K and X. According to them, Q is evidently a C and U joined together. It is not enough that the sound is the same, but they see the traces of the CU in the figure of the Q; the V being only laid obliquely, so as to come within the cavity of the C; as C <.

To confirm this, they say the ancients wrote *qi*, *qæ*, *qid*. Though Jos. Scaliger, Littleton, &c. think this is no proof of the point; for in Gruter's inscriptions we find not only the Q, but also the C, put for QU; as *Cintus*, *Quintus*; *fiscis* for *fiquis*, &c. Yet nobody ever imagined the C a double letter.

Q, among the *Ancients*, was a numeral letter, signifying 500; as in the verse,

“Q velut A cum D quingentos vult numerare.”

A dash over it, as $\overline{Q}$, denoted it to signify five hundred thousand.

Q is also used as an abbreviature in several arts. Q. *pl.* in physicians' bills, stands for *quantum placet*, or *quantum vis*, as much as you please of a thing; *q. s.* for *quantum sufficit*, or as much as is necessary.

Q, in the proper names of the Romans, signifies Quintus, or Quintius. Upon the French coins this letter denotes that they were struck at Perpignan.

Q seems the initial of no word in *Musæ*, except in old madrigals, where it frequently is placed at the top of the page for *quinta pars*, the fifth part, in a polyphonic composition.

Q. D. is frequently used, among *Grammarians*, &c. for *quasi dictum*, as if it were said, &c. or as who should say.

Q. E. D. among *Mathematicians*, signifies *quod erat demonstrandum*, which was to be demonstrated.

Q. E. F. *quod erat faciendum*, which was to be done.

QUAB, in *Ichthyology*, the name of a Russian fish, which some report to be at first a tadpole, then a frog, and at last a fish. Dr. Mounsey, who made many enquiries concerning these pretended changes, apprehends that they are all fabulous. He had an opportunity of seeing the fish itself, and found that they spawned like other fishes, and grew in size, without any appearances to justify the report. He adds, that they delight in very clear water, in rivers with sandy or stony bottoms, and are never found in standing lakes, or in rivers passing through marshy or mossy grounds, where frogs choose most to be. Phil. Trans. vol. xlv. p. 175.

QUABES, in *Geography*, a people of Africa, in the interior country between Rio Sestos and Sierra Leona, inhabiting the southern banks of the river Sestos. They had been formerly conquered by Flanfire, king of Folgia; but having thrown off their subjection, they have since remained a free people, though under the protection of the emperor of Monou, or Manou; which empire is called by English geographers, and also by M. d'Anville, Mendi Manow.

QUACHA, or QUAGGA, in *Zoology*. See EQUUS.

QUACHILTO, in *Ornithology*, the name of a very beautiful Brazilian bird, of the moor-hen kind, called also *yacacintli*, and *porphyrio Americanus*. It is the *FULICA Purpurea*, (which see); and is of a fine blackish purple colour, variegated with white; its beak is white while young, but becomes red as it grows older, and has a naked space at its basis, resembling, in some sort, the coot; its legs are of a yellowish-green; it lives about the waters and feeds on fish, yet is a very well-tasted bird. It imitates the crowing of a common cock, and makes its music early in the morning. Marggrave's Hist. Brasil.

QUACHY, in *Zoology*, a name given to the *Coati*, or *VIVERRA Naja*; which see.

QUACK, in *Medicine*. See EMPIRIC.

QUACKENBRUCK, in *Geography*, a town of Westphalia, in the bishopric of Osnabruck, situated on the river Hase, which runs through it in seven streams, that unite in two below the town; 20 miles N. of Osnabruck. N. lat. 52° 42'. E. long. 8° 3'.

QUADIANS, QUADI, in *Ancient Geography*, a people of Germany, whose territories extended from the Danube to Moravia, and the northern part of Austria. They are comprehended by some writers under the ancient name of Suevi, part of whom forced their way into Spain, and formed a kingdom there. Their country is at present known by the name of Moravia; for it extended from the mountains of Bohemia to the river Marus, now the March, and consequently comprised that province. Ptolemy mentions the following cities in the country of the Quadians; viz. Eburodunum, Eburum, Medoslanum, and Celemantia, now, according to Cluverius, Brin, Olmutz, Znain, and Kalminz. The Quadians were a warlike people, had kings of their own, and agreed in customs, manners, and religion, with the other German nations. They, without doubt, joined their countrymen against Lollius, Germanicus, Caius, and Galba, who attempted to reduce Germany, and to subdue the several nations which inhabited that extensive country. The emperor Domitian marched against them, but was defeated

by the Marcomans, and put to flight. The Quadians submitted to the emperor Titus Antoninus, and it appears by his coins, supposed to have been struck about the year 139, that they acknowledged, as sovereign, a king appointed by that prince. They joined the Marcomans, in the famous war made by that people on the empire under the reign of Marcus Aurelius; but being reduced to great distress they sent ambassadors to sue for peace, and with them they restored all the Roman deserters, and about 13,000 prisoners, whom they had taken during the war. They thus obtained peace, upon condition, that they should not traffic, for the future, within the Roman dominions, nor settle within six miles of the Danube; but, disliking these conditions, they again joined the Marcomans, and renewed the war. In the prosecution of this contest, which was long and sanguinary, they were totally defeated; their king Ariogeses was taken prisoner; but the emperor spared his life, confining him to the city of Alexandria, the metropolis of Egypt. The Quadians, however, seem to have continued in arms till the reign of Commodus, who granted them peace upon the following terms: that they should keep at the distance of five miles from the Danube;—that they should surrender their arms, and supply the Romans with a certain number of troops when required;—that they should assemble but once a month in one place, and in the presence of a Roman centurion;—and that they should not make war upon the neighbouring nations without the consent of the people of Rome. In the year 214, the king of the Quadians was Gaibomar, who was assassinated by order of Caracalla. In the 4th year of the reign of the emperor Valerian, the Quadians joined the Sarmatians, and invading Illyricum, ravaged that province; but they were defeated by Probus, then tribune of a legion, and afterwards emperor. In the year 260, the 7th of the emperor Gallienus, they made a sudden irruption into Pannonia, but they were expelled, without their booty, by Regilianus. Upon the death of Probus, who had kept the barbarians in awe, A.D. 283, the Quadians, in conjunction with the Sarmatians, broke into Illyricum and Thrace, and having ravaged those provinces, and advancing towards Italy, they were met by Carus, the successor of Probus, on the borders of Illyricum, and totally defeated; 16,000 being killed on the spot, and 20,000 being taken prisoners. In the 19th year of the emperor Constantius, the Quadians made an irruption into Pannonia and Mœsia; and having pillaged both provinces, returned home with an immense booty. They returned again in two years, and laid waste Valeria. Constantius was provoked by these invasions, and leaving Milan, advanced to the confines of the Quadians, and conferred with their chiefs, who excused past hostilities, and promised, for the future, to live in peace and amity with the emperor. They soon, however, forgot their promise; and in the following year joined the Sarmatians, and laid waste a great part of Pannonia and Mœsia: but at the approach of Constantius, they repassed the Danube, and returned home. The emperor determining to punish them for their treachery, passed the Danube on a bridge of boats, and began to destroy their country. The Quadians, unable to resist, sued for peace, and obtained it, upon delivering up hostages, and setting at liberty all the prisoners they had taken. In the year 374, their king Gabinius being treacherously murdered by Marcellianus, duke of Valeria, they crossed the Danube in the utmost rage, and falling upon the reapers, in harvest time, killed the greatest number of them, laid waste the country, and took many captives. They afterwards followed Equitius, general of the troops in Illyricum, who had been

accessory to the murder of their king, into Valeria, and committed dreadful devastations in the countries through which they passed. In their way they met with two legions, the Pannonian and Mœsian, who had been sent to oppose them, and taking advantage of a contest which subsisted among them about precedence, they cut them both in pieces. In this irruption the Quadians had been joined by the Sarmatians; but the latter were defeated with great slaughter by Theodosius, then duke of Mœsia, and afterwards emperor. Against the Quadians Valentinian I. marched in person; and having made great preparations for his proposed expedition into their country, he took the field; passed the Danube at Acinium, now Gran, or Buda, in Lower Hungary, entered the enemy's country, and destroyed it with fire and sword. At length, the Quadians sued for peace; but whilst the emperor was speaking to the messenger with great warmth, and threatening to extirpate their whole nation, he fell to the ground in a fit, and soon afterwards expired. Upon his death a treaty was concluded with the Quadians. Their restless spirit and disposition for war manifested themselves again in the year 379, when they invaded Illyricum; but they were driven out, with some loss, by the emperor Gratian. In 407 they entered Gaul with the other barbarians, over-ran its provinces, and committed dreadful ravages. From this time no farther mention is made of the Quadians; so that they were either subdued, or utterly extirpated by the Goths, who had settled in Pannonia and Illyricum. *Anc. Un. Hist.* vol. xvii.

QUADRA, in *Building*, any square border, or frame, encompassing a basso-relievo, pannel, painting, or other work.

The word is also used, erroneously, for a frame or border, of any other form; as round, oval, or the like.

QUADRA and VANCOUVER'S *Island*, in *Geography*, a name given to the island of Nootka, in compliment to signor Quadra, the Spanish commander at Nootka Sound, and captain Vancouver, who expected to obtain possession of the settlement in the year 1792. See *NOOTKA*, and *NOOTKA Sound*.

QUADRAGESIMA, a term sometimes used for the time of Lent, because consisting of forty days.

Hence some monks are said to lead a quadragesimal life; or to live on quadragesimal food all the year.

QUADRAGESIMA *Sunday* is the first Sunday in Lent; so called because it is about the fortieth day before Easter.

On the same account, the three preceding Sundays are called Quinquagesima, Sexagesima, and Septuagesima.

QUADRAGESIMALS, QUADRAGESIMALIA, denote Mid-lent contributions, or offerings.

It was an ancient custom for people to visit their mother-church on Mid-lent Sunday, and to make their offerings at the high altar; and the like was done in Whitsun-week. But as these latter oblations, &c. were sometimes commuted for by a payment of pentecostals, or Whitsun-farthings; so were the former also changed into a customary payment, quadragesimals, denarii quadragesimales; and sometimes Letare, Jerusalem, from a hymn so called, sung on that day, beginning "Jerusalem, mater omnium," &c.

QUADRANGLE, in *Geometry*, a quadrangular, or quadrilateral figure; or a figure which has four sides, or four angles.

To the class of quadrangles, or quadrangular figures, belong the square, parallelogram, trapezium, rhombus, and rhomboides.

A square, &c. is a regular quadrangle; a trapezium, an irregular one.

Quadrangular figures are not proper for fortification; the flanks, and flanked angles, being too small.

QUADRANGULARIS PISCIS, the *Square-fish*, in *Ichthyology*, the name of a fish, which, in its most usual size, is about fifteen inches long, four inches high in the middle, and three inches and a half over; the forehead is square, a little hollow, and, by the eminence of the eye-brows, two inches and a half over; the nose blunt, and not very steep, with two holes in the place of nostrils, and the mouth very small; the back is a little convex toward the tail, and on the sides a little obtusely angled; as is also the belly, which is plain and flat, and a little rising toward the tail; it has five fins, two near the gills, two near the tail, and the tail-fin, which is considerably long. Part of the head and tail are covered with a soft skin, the rest of the body with a kind of crust, adorned all over with little round knots, reduced for the most part into hexagonal figures, and subdivided into equilateral triangles. *Grew, Mus. Reg. Sac.* p. 110.

QUADRANS, in *Antiquity*, the fourth part of the *as*, or pound. See *As*.

QUADRANS, in our *Customs*, is the fourth part of a penny, or a farthing.

QUADRANT, QUADRANS, in *Geometry*, an arc of a circle, containing 90 degrees, or one-fourth of the entire periphery.

Sometimes, also, the space, or area, included between this arc and two radii, drawn from the centre to each extremity thereof, is called a quadrant, or, more properly, a quadrantal space; as being a quarter of the entire circle.

QUADRANT also denotes a mathematical instrument, of great use in navigation and astronomy, for the taking of altitudes, angles, &c.

The quadrant is variously contrived, and furnished with different apparatus, according to the several uses for which it is intended; but they have all this in common, that they consist of a quadrant, or quarter of a circle, whose limb is divided into 90 degrees; and that they have a plummet suspended from the centre; and are furnished with pinnulæ or sights, through which to look.

QUADRANT, the *Common*, or *Surveying*, (represented *Plate VI. Surveying, fig. 13.*) is made of brass, wood, or other matter, usually twelve or fifteen inches radius. Its circular limb is divided into 90°, and each of those subdivided into as many equal parts as the space will allow, either diagonally or otherwise. On one edge, or semi-diameter, are fixed two immoveable sights; and in the angle, or centre, is hung a thread, with a plummet. To the centre is likewise, sometimes, fixed a label, or moveable index, bearing two other sights, like the index of a telescope. And, in lieu of the immoveable sights, there is sometimes fitted a telescope; though this more peculiarly belongs to the astronomical quadrant.

On the under side, or face, of the instrument, are fitted a ball and socket; by means of which it may be put in any position, for use.

Besides the essentials of the quadrant, there is frequently added on the face, near the centre, a kind of compartment, called the *quadrat*, or *geometrical square*; as in the figure; this, in some measure, making a distinct instrument of itself. See its description and use under the article *QUADRAT*.

The quadrant is to be used in different situations, according to the dimensions to be taken. To observe heights and depths, its plane is disposed at right angles to the horizon; but to take horizontal distances, the plane is disposed parallel to it.

Heights and distances, again, may be taken two ways;

viz. by means of the fixed sights and plummet, and by the label.

QUADRANT, Use of the Surveying. *To take the height or depth of an object with the fixed sights, and plummet.*—Place the quadrant vertically, and the eye under the sight next the arc of the quadrant: thus direct the instrument to the object, *e. gr.* the top of a tower, till the visual rays of it strike through the sights upon the eye.

This done, the portion of the arc intercepted between the thread and the semidiameter, on which the sights are fastened, shews the complement of the object's height above the horizon, or its distance from the zenith; and the other portion of the arc intercepted between the thread and the other semidiameter, shews the height itself of the object above the horizon.

The same arc likewise gives the quantity of the angle made by the visual ray, and a horizontal line, parallel to the base of the tower.

Note, to observe depths, the eye must be placed over that sight next the centre of the quadrant.

From the height or depth of the object in degrees thus found, which suppose $35^{\circ} 35'$; and the distance of the foot of the object from the place of observation carefully measured, which suppose 47 feet; its height or depth in feet, yards, &c. is easily determined by the most common case in trigonometry.

For we have here, in a triangle, one side given, *viz.* the line measured, and we have all the angles; for that of the tower is always supposed a right angle: the other two, therefore, are equal to another right angle; but the angle observed is $35^{\circ} 35'$, therefore the other is $54^{\circ} 25'$.

The case, then, will be reduced to this: as the sine of $54^{\circ} 25'$ is to 47 feet, so is the sine of $35^{\circ} 35'$ to a fourth term, *viz.* $33\frac{1}{2}$ feet; to which add the height of the observer's eye, suppose 5 feet; and the sum, $38\frac{1}{2}$ feet, is the height of the tower required.

QUADRANT, the farther use of the, in taking of altitudes of objects, both accessible and inaccessible, see under the article ALTITUDE.

QUADRANT, Use of the, in taking heights and distances by the index and sights.—To take, *e. gr.* a height, as that of a tower whose base is accessible; place the plane of the instrument at right angles to the plane of the horizon, and one of its edges parallel to it, by means of the plummet, which, in that case, will hang down along the other. In this situation turn the index, till, through the sight, you see the top of the tower; and the arc of the limb of the quadrant between that side thereof parallel to the horizon and the index will be the height of the tower in degrees; whence, and from the distance measured as before, its height in feet, &c. may be found by calculation, as in the former case: or, without calculation, by drawing from the data, on paper, a triangle similar to the great one, whose base is the distance; and its perpendicular, measured on the scale, is the height of the tower.

QUADRANT, Use of the, in measuring horizontal distances.—Though the quadrant be a less proper instrument for this purpose than a theodolite, semicircle, or the like, because angles greater than quadrants cannot be taken by it, yet necessity sometimes obliges persons to have recourse to it.

The manner of its application is the same with that of the semicircle; all the difference between the two instruments consisting in this, that the one is an arc of 180° , and can therefore take an angle of any quantity; and the other is only an arc of 90° , and is therefore confined to angles of that quantity. See, therefore, SEMICIRCLE.

QUADRANT, in Astronomy, is an instrument by which

the altitude of a heavenly body is measured, and is composed of one-quarter, or one-eighth of a circle, accordingly as the measurement is made by means of direct vision, or by the reflected image of the object to be viewed. When a suspended circle was made use of with revolving sights, called an altrolabe, the accuracy of an observation could never be depended on, partly because the radius was small, and partly because the instrument vibrated when suspended by the hand, and was otherwise inconvenient to use, as well as liable to have its equipoise disturbed by the various positions of the index and sights: therefore, such a portion of the circle was adopted as was competent to measure the greatest possible altitude, and an increase of radius was thereby obtained, which promised to contribute to accuracy, without affecting the portability of the instrument. But though the construction was varied by different ingenious men, the quadrant was but little, if at all, conducive to the improvement of nautical or of astronomical science, till the application of telescopic sights, and an improved mode of graduating the limb, together with the addition of a vernier scale, gave it powers on which the mariner and astronomer could confide. Quadrants have been constructed of different materials, such as wood, ivory, brass, &c. and of various dimensions, agreeably to the uses for which they were intended, in order to accommodate purchasers of every denomination; but as it is not our province to notice every plaything that has usurped the appellation of quadrant, we will confine our account to such instruments chiefly as have been of actual service in navigation and astronomy. We have, however, already anticipated the history, we might here have introduced, of the various improvements successively made in quadrants, at the beginning of our article CIRCLE; and under the article GRADUATION we have given, at considerable length, the different methods of dividing and subdividing astronomical instruments in general; to which articles we beg to refer our readers, who wish for information on those points, and which may be read in conjunction with our present article.

Our arrangement of quadrants will be most systematic, if we divide them into two classes, *viz.* those which measure altitudes by direct vision, and those which determine measurements in all directions, vertically, horizontally, and obliquely, by means of reflection. The former class have been found useful in astronomy chiefly, and the latter in navigation, where the motion of a ship interferes with the steadiness of any fixed position of an instrument.

The first quadrant, in its rude state, was probably a quarter of the altrolabe enlarged, with fixed sights placed in, or parallel to, the vertical line passing through zero; and a fine thread, or wire, stretched by a plummet, indicated the altitude on the divided limb, according to the representation in *fig. 4. of Plate I. of Astronomical Instruments*. This construction might be used in observations of the sun, without injuring the eye of the observer, by allowing the solar ray to pass through the first sight-vane, or hole, so as to fall on the second, at some distance from the former, while the thread rested nearly in contact with the elevated limb; but the want of minute, and at the same time accurate subdivisions, and the sensible thickness of the thread, were impediments to accuracy that did not admit of remedy, until another mode of reading the altitudes was devised, and until a method was contrived of rendering the light of the sun tolerable to the eye of an observer. The former of these desiderata was accomplished first by diagonal scales, with a fiducial edge of an index, and afterwards by that admirable contrivance, sometimes called a Nonius, but more properly denominated a Vernier, from the name of its inventor;

ventor; the latter was effected by semi-opaque glass, introduced at first without, but afterwards, with better effect, with telescopic sights; at the same time, enlarging the visual angles subtended by the sun, and yet diminishing the intensity of his light by a partial transmission through the smoked or coloured glass.

Davis's Quadrant, or Back-Staff.—In the year 1590, captain John Davis, a native of Sandridge, near Dartmouth, previously to his sailing into the South seas under the command of Mr. Cavendish, contrived that instrument, which is represented in fig. 2. of Plate I. of *Astronomical Instruments*, and which has been called the *English quadrant*, or *back-staff*. This instrument dispensed with the use of the plumb-line, and consequently was better adapted to nautical purposes than the old quadrant, or than the fore-staff, that preceded it; but wanted the telescopic sights, which have given subsequent instruments the advantage over it. It was, however, probably the first quadrant in which the horizon was used as one of the objects in a back observation, and from which the reflecting instruments afterwards borrowed an useful principle, where altitudes are concerned; though it was in the use of the *fore-staff*, (described under our article CIRCLE,) that the horizon was first made one of the extreme limits of an altitude, taken by a forward observation. Captain Davis found that pear-tree answered very well as the material on which his instrument was constructed, and an ingenious arrangement of two divided arcs and three vanes constituted his plan, according to the following description. The vane at A was called the horizon-vane; the one seen at B the shade-vane, because its shadow fell on the horizon-vane during the instant of completing an observation; and the third, at C, was denominated the sight-vane, by reason of its being the vane to which the eye was applied in taking an observation. The arc of smaller radius, DE, contained 60° , and the other, FG, of larger radius, contained only 30° , in continuation of the former, making together the whole quadrant. The arc DE was divided into whole degrees only, on account of the smallness of its radius; but the arc FG had its degrees subdivided by concentric and diagonal lines, as seen in the figure. The manner of ascertaining the altitude of a heavenly body, by the joint use of these two arcs, is not obvious at first sight of the instrument, but may be thus explained. When the altitude of the sun is taken, the horizon-vane is fitted to the extreme end or centre A of the quadrant, and the shade-vane B is put to within about 10° or 15° of the supposed co-altitude, but to a less quantity than the co-altitude, while the sight-vane remains for adjustment on the arc FG. Things being in this state, the back of the observer is turned to the sun, and the quadrant is so elevated, that the shadow of the upper edge of the shade-vane B falls upon the upper edge of the slit in the horizon-vane A, when viewed through the small hole in the sight-vane. If now, in this situation, the horizon is seen through the said slit, the observation is exact; but if not, the sight-vane is moved backwards or forwards on the arc FG, accordingly as the sky or sea is seen, till the horizon appears in its place, while the shadow of the shade-vane rests on the required situation in the slit of the horizon-vane, and then the observation is finished; and the sum of the two readings on the respective arcs, B and C, as read by the fiducial edges of the vanes, is the co-altitude or zenith distance of that limb of the sun, upper or lower, which was observed from the corresponding limb of the shadow. If a lens, of a focal length equal to the radius of the smaller arc, were used, the focal luminous point occasioned thereby would be a better object to measure the place of, than a shadow with an edge not sufficiently

defined. This instrument, it should seem, was not capable of taking the altitude of a star or planet, nor of the moon, unless her disc was large enough at the time to project a shadow.

Elton's Quadrant.—An index bearing a spirit-level, with a vernier scale near the sight-vane, was added to the quadrant of Davis some time afterwards, by one Elton, the use of which was to take altitudes *without an horizon*; but the similarity of the two instruments renders a more particular description of this addition superfluous. An inspection of fig. 8. Plate I. will sufficiently explain the difference.

Gunter's Quadrant.—Among the numerous and useful contrivances of the ingenious professor of astronomy in Gresham college, was a portable quadrant, which now claims our attention, and which was contrived in, or a little before, the year 1618. The object of the inventor was not to construct an instrument capable of measuring altitudes more accurately than that of captain Davis, which we have just described, but to make a quadrant so comprehensive in its uses, that, like the logarithmic scale, which he divided, it might shew by inspection results, which had previously required long and tedious calculations; and in this point of view it is still to be considered. Besides the quadrantal arc for measuring altitudes, this instrument has various curves stereographically projected on it, such as the equator, the tropics, the ecliptic, and the horizon, on a supposition that the eye is situated in one of the poles, all which are represented in fig. 3. of Plate XXIII. of *Astronomical Instruments*. The projection, according to Bion, is thus effected; when the quadrantal arc BC has been graduated, from its centre A, with a convenient radius AT, describe the arc TD to represent one of the tropics; and let the line AT be taken as the tangent of $56^\circ 46'$, or half the sun's greatest declination (supposed here to be $23^\circ 32'$), added to the radius or tangent of 45° ; then to find the point E in this line for the equinoctial, there will be this proportion, as the tangent of $56^\circ 46'$: 1000 :: radius : 655; and therefore, if $\frac{655}{1000}$ parts of the line AT be taken, it will be the proper radius of the arc EF, or equinoctial.

To find the centre of the occult arc ED, which represents the ecliptic, let the meridional line AD be so divided by the point G, that if AF be taken as radius, AG may be the tangent of $23^\circ 32'$, the sun's greatest declination; in which case AG will be $\frac{1000}{1000}$ of the line AF, and the occult arc ED described from the point G will be one-fourth of the ecliptic, which may be divided into signs and degrees thus: as radius is to the tangent of any degree's distance from the nearest equinoctial point, so is the co-sine of the sun's greatest declination, to the tangent of that degree's right ascension; for example, supposing the right ascension of the first point of γ to be $27^\circ 54'$, draw a line from A, the centre of the quadrantal arc, to this degree and minute on the said arc, and note where it intersects the occult arc of the ecliptic, and this point will be the beginning of the sign γ ; and in like manner any other part may be inserted.

The line ET, or line of declination, may be divided thus; taking AE for the radius of the equinoctial, or tangent of 45° , let the tangents of 46° , 47° , 48° , &c. up to $68^\circ 30'$, be successively taken and laid down on the line ET, and the points of excess above the tangential point of 45° will be the dividing lines of the scale for 1° , 2° , 3° , &c. up to $23^\circ 32'$, or greatest declination.

When the scale of declination is finished, the quadrantal arc may be taken as the measure of right ascensions, and then the place of a star or any other heavenly body may be inserted on the plane of the quadrant thus; let a line be

drawn

QUADRANT.

drawn from A to the degree and minute of right ascension, counted from B towards C, and the point in this line, where an occult arc, drawn through the declination from the centre A, intersects it, will be the place of the heavenly body in question.

The two parallel arcs contained between the tropic TD and the quadrantal arc BC, are the scales of days and months, which are divided by the aid of a table of meridian altitudes of the sun for each day, calculated for the particular latitude, for which the quadrant is constructed. It is hardly necessary to observe, on the construction of such table, that if the latitude and declination be both north, or both south, the declination must be added to the co-latitude for the greatest altitude; but if of contrary denominations, subtracted. The degrees and minutes contained in such table are transferred into the scale of months by a line extending across it from the centre A to the quadrantal arc, as before.

The centre of the horizon will be in the meridional line AC, and if a point H be taken such, for the co-latitude $38^{\circ} 28'$ for instance, that AH may be the corresponding tangent to radius AF, then $\frac{7}{10}$ of that radius will be its distance from A, and the occult arc described from H, with the extent HE, beginning at E in the equinoctial, and ending at the tropic TD, will be the required horizon. This horizontal arc may be divided thus; as radius is to the sine of the latitude, so is the tangent of any number of degrees in the horizon, to the tangent of a corresponding arc in the quadrant; and from a table thus constructed any point in the horizon may be put in by intersection of a line drawn from A to the tabular number as read on the quadrantal arc, as in the former cases.

A third table of the sun's altitude for inserting the hour lines may be calculated thus; when the sun is in the equator, as radius is to the co-sine of the latitude, so is the co-sine of any hour from the meridian, to the sine of the sun's altitude at that hour; but when the sun has declination, say, as the co-sine of the hour from the meridian is to radius, so is the tangent of the latitude, to the tangent of a fourth arc; then if the latitude and declination have like denominations, and the hour fall between noon and six o'clock, subtract the declination from the said fourth arc, and the remainder will be a fifth arc; but if the latitude and declination have unlike denominations, or the hour be between six and midnight, add the declination to the fourth arc, and the sum will be a fifth arc, which must be thus used; as the sine of the fourth arc, is to the sine of the latitude, so is the co-sine of the fifth arc, to the sine of the altitude sought. The determination of such table by this fundamental method is however operose, and Margett's horary tables, which give the successive altitudes in any given latitude, would greatly shorten the labour, by giving the results by inspection, which may at the same time be inserted by transfers from the quadrantal arc, similar to those we have already described. When the horary points are put in for each successive hour, when the sun is in the equator, at each tropic, and at a few intermediate places, the horary lines may be drawn through the said points, which will give the hour for any given day, when the instrument is used as hereafter described.

A fourth table, for putting in the azimuth lines, will require the sun's altitude to be calculated for each degree of azimuth, when the sun is at the equator, at each tropic, and at other intermediate places, which may be done thus: when the sun is in the equator, as radius is to the co-sine of the azimuth from the meridian, so is the tangent of the latitude, to the tangent of the sun's altitude at the

azimuth in the equator: but out of the equator the rule is, as the sine of the latitude, is to the sine of the declination, so is the co-sine of the sun's altitude at the equator at a given azimuth, to the sine of a fourth arc. When the latitude and declination have the same name, in all azimuths from the prime vertical to the meridian, add this fourth arc to the arc of altitude at the equator; but when the azimuth is above 90° , subtract the altitude at the equator from this fourth arc; also when the latitude and declination have unlike names, subtract the said fourth arc from the arc of altitude at the equator, for the altitude at the proposed azimuth. The points corresponding to the tabular numbers, thus ascertained, must be inserted by intersection of lines drawn from A, as before, to the quadrantal arc BC, and lines uniting those points will be the lines of azimuth for each hour in every day of the year. But to complete the instruments, two sights or vanes must be fixed on the meridional line AC, and a small plumb-line, with an adjustable bead, must be suspended from the point A of the quadrant.

In addition to the lines already described, Gunter's quadrant has sometimes a square under the angular point A, called a *quadrat*, as seen in the figure, two sides of which are divided into ten equal parts each, and these again subdivided into others, the use of which is to measure angular distances; and sometimes the large square is subdivided into a number of smaller ones, for the purpose of performing arithmetical proportions by inspection. See Bion on the Construction and principal Uses of Mathematical Instruments.

It would be tedious to enumerate all the uses of this quadrant, and to exemplify all the problems that it is capable of performing, or rather of illustrating (for great accuracy cannot be expected in the indication of so small an instrument); but we will specify a few of the most useful, which may be varied by reverting the processes, and by altering the data, to a great extent.

PROBLEM I.—*To find the Sun's Right Ascension.*

Stretch the thread from the point A over the sun's place, as marked in the graduated ecliptic, and the degree cut by it in the quadrantal arc will give the corresponding right ascension.

PROB. II.—*To find the Sun's Declination.*

Stretch the thread as before, and slide the bead till it rests on the sun's place for the given day, and then turn it to the scale of declination, where the corresponding degree will be seen under the bead.

PROB. III.—*To find the Sun's Meridian Altitude on any Day.*

Extend the thread over the day of the month given, in its proper scale, till it reaches the quadrantal arc, and the sun's greatest altitude for that day will be indicated thereby.

PROB. IV.—*To find the Hour of the Day.*

Extend the thread over the day of the month, and, holding it there, slide the bead till it lies on the line of twelve o'clock; then elevate the quadrant so that the solar ray may pass through the upper sight-hole exactly upon the second, and allow the plummet to rest, and then the bead will indicate the hour, before or after noon, as the case may be. In a similar manner the sun's altitude may be measured by the thread falling on the quadrantal arc, when the solar ray passes as above described.

PROB. V.—*To find the Sun's Amplitude.*

Let the bead be rectified for the given time, and be brought

brought afterwards to the horizon, while the thread remains stretched, and it will indicate the rising or setting amplitude, as the case may be.

PROB. VI.—*To find the Ascensional Difference.*

Rectify the bead as in the last problem, and bring it to the horizon, in which situation the thread, extended to the quadrantal arc, will shew the ascensional difference in degrees, which converted into time will shew how much the sun rises before six in summer, and after six in winter, and consequently will give the exact length of the given day.

PROB. VII.—*To find the Sun's Azimuth.*

Rectify the bead for the given time, and observe the sun's altitude as explained in prob. 4. Then extend the thread to the complement of that altitude, and the bead will indicate the azimuth corresponding, and *vice versa*.

PROB. VIII.—*To find the Hour of the Night by a Star.*

Put the bead on the thread to the distance that will indicate the star's declination, and look through the sight for the star till the plummet rests on the plane of the quadrant, and in that situation the bead will shew, in the hour lines, the star's distance in time from the meridian of the place; in the next place subtract the sun's right ascension in time from that of the star, as given in some catalogue, and to the remainder add the observed distance from twelve o'clock in sidereal time, and the sum will be the hour nearly, or the approximate distance of the sun from noon, which may be corrected by applying the sun's variation of right ascension since the preceding noon, which in every six hours will be about a minute.

Sutton's quadrant, and Collins's sector on a quadrant, are very similar, both in construction and use, to the quadrant we have here described, and the dial on a card, by Ferguson, is nearly related to it, particularly as it has been lately improved by the Rev. W. Pearson.

Of Astronomical Quadrants.—The quadrants which we have hitherto described may be considered as by no means perfect, but as approximating only to an instrument, that is really useful in an observatory for determining the exact place of a heavenly body; hence the quadrant which we propose next to describe, has obtained the name of *astronomical*, from its superior pretensions to accuracy in the measurement of altitudes taken above the horizon, and therefore merits our more particular attention.

An astronomical quadrant may be either portable or fixed; in the former case it is usually mounted on a tripod, with adjusting screws in the feet, and has a horizontal motion as well as a vertical one, in order that it may take altitudes in any azimuth, or be made to follow the body observed in its apparent path; but in the latter case it is fixed against a steady wall, with its plane in, or very nearly in the meridian, and is therefore denominated a *mural quadrant*.

The first astronomical quadrant, of which we have any account left us, is that which Ptolemy used; it was the fourth part of a circle placed fast against a stone pier, or quadrangular log of wood, with zero of the arc in the horizontal line, and a pin of wood projecting from the central point threw a shadow on the limb when the sun shone, which shadow was used by way of index: but it is obvious that much accuracy was not to be expected from such an instrument, however well constructed or divided. We might mention here the quadrants of Tycho Brahe and Hevelius, but the former has been noticed under our article CIRCLE, and the latter was destroyed in the conflagration of the owner's house in Dantzic. In more recent times, astrono-

mical quadrants have been made on accurate principles, and with great care, especially by Graham, Sisson, Bird, Ramsden, Cary, and Troughton, several of whose instruments we will now describe, as far as any difference in their construction renders distinct accounts necessary. We will proceed, as we have done on former occasions, chiefly in the order of time, which, generally speaking, will be found to be also in the order of successive improvements.

Mural Quadrant by Graham.—Before we proceed to describe the mural quadrant, contrived and made by Graham, and fixed at the west side of the stone pillar in the middle room at the Royal Observatory at Greenwich, at the expence of king George I., and for the use of that eminent astronomer Dr. Halley, it may be proper to mention that Flamsteed, and his assistant Sharp, had previously used an arc of a circle fixed against a stone pier in the meridian, which they had themselves constructed, and which was removed at Flamsteed's death. We must, therefore, consider their instrument as having been the prototype of Graham's mural quadrant, or arc, as it has been also called sometimes. In fig. 4. of Plate XXIII. of *Astronomical Instruments*, is given a representation of the mural quadrant of Graham's construction, which will equally represent that of Bird, constructed after the same model, and which is the same that both Dr. Smith, and Stone, the editor of Bion's work, have given in their respective accounts.

The body of this quadrant is composed chiefly of bars of iron united together, as seen in the figure; some, to form the plane of the quadrant, placed flat-ways; and others, to give strength and stability, fixed edge-ways. These bars are all of the same dimensions, namely 2.9 inches wide, and 0.175 thick, and are united together by right-angled short bent bars in various places, both at the intersections made by the sides of the small squares, and at other situations, so that while great firmness is obtained, great weight is avoided. The quadrantal arc is composed of two bars, one of iron, united to the iron frame, and the other of brass, on which the divisions are made, as described under our article GRADUATION; this brass bar is pinned fast to the iron one, and being more slender than the iron, accommodates itself thereto, and, as time has proved, does not alter the shape of the arc, as we have lately been assured by Mr. Troughton. The breadth of the limb is 2.2 inches, the brass limb being more remote than the anterior edge of the iron arc by 1.2 inch, and the surface was planed, or rather scraped, by a tool fixed to a radial bar, that revolved on a vertical axis of motion, placed in the centre of the arc, and resting with its superior end in a fixed beam above the plane of the quadrant, when this plane was lying in a horizontal position, it being impracticable to put so large a body in any ordinary lathe. The original divisions of Graham were inserted on two separate arcs, one graduated into 90° and its subdivisions, and the other divided into 96 parts and its subdivisions, as we have before explained in the article just referred to; but the divisions, being laid down by rough dividing, are not now made use of, but a quadrantal arc of 96, with its subdivisions, put in by Bird in 1753 between the two arcs of Graham, is that which all observations taken by Graham's quadrant are now referred to, and the readings are transformed into degrees, minutes, and seconds, by an appropriate table. The readings were at first obtained by a double vernier-piece carried by the telescope, that revolves round the centre of the arc, one side of which vernier-piece read with the arc 90°, and the other with the arc of 96 parts, or grand divisions; the degree was subdivided into 12 parts, or 5' spaces, and 10 parts on its vernier equalled 11 out of the said 12 parts, so that

$\frac{1}{17}$ of a degree, or $5\frac{1}{2}$, was the length of one of the vernier divisions, and $\frac{1}{17}$ of this, or $30''$, was the smallest quantity indicated by this vernier; but on the arc of 96 grand divisions there was, as in Bird's arc, 16 equal parts, or subdivisions, in every grand division, and the vernier for this arc had 17 divisions on it, occupying the space of 16 subdivisions in the arc, so that the length of this

vernier was $\frac{17}{16}$ of $\frac{90^\circ}{96} = 59'.83$ nearly, and one division

of it $\frac{59'.83}{17} = 3'.52$ nearly.

Hence in the first vernier its number 11 is *one less* than its equivalent arc contains on the limb of 90° ; but in the second, the number 17 is *one more* than its equivalent arc contains in the arc of 96 parts, on which account the reading of one vernier is in the direction from right to left, but that of the other, on the contrary, from left to right; one meets, and the other overtakes the dividing strokes of the divided limb; and for the same reason, in the common Hadley's quadrant, or rather octant, sometimes 19 subdivisions, and sometimes 21 on the limb, act against 20 in the vernier, but then the readings are *not* in the *same direction*. The telescope is clamped to the arc in any situation by the mechanism for slow motion in the usual way, which probably was first adopted in one of the large quadrants, and its counterpoise beyond the centre of the arc, gives it the advantage of remaining in any position. It has cross hairs in the focus of the eye-glass. When the lines of the vernier are none of them coincident with any one on the limb of either quadrantal arc, the portions less than what the verniers profess to indicate were *estimated* by the eye, by examining the situation of other pairs of dividing lines, to the right and left of those nearest to a coincidence; and to a want of a micrometrical nut to the screw of slow motion may be attributed the remark, that has been made, that the readings thus taken, even with so large radii as 96.85 and 95.8 inches, were not to be depended upon to $10''$. That the motion of the telescope might be quite easy, and that the centre of the quadrant might be relieved of its weight, the following contrivance was introduced; *ab* represents an iron axis laid across the top of the wall, having two brass plates fixed perpendicularly to its ends, with notches cut in them for this axis to turn in, which axis points to the centre of the quadrant at right angles to its plane: to that end of it next to the quadrant, at *a*, an iron arm, *cd*, is fixed, having two brass plates, *ce*, *df*, almost perpendicular to it; to these are rivetted two slender slips of deal, whose remote ends meet at *g*, near the eye-piece of the telescope, and are held together by a brass cap. Through a small plate fixed to one side of a collar, embracing this lower end of the telescope, there passes a screw-pin at *g*, parallel to the telescope; which pin, being screwed into the cap at the end of the said slips of deal, holds up the telescope against the centre-work, while the slips are braced by other cross slips of the same light wood. The counterpoise *i* is supported by the rod *hi* at *b*, the retiring end of the axis *ab*; and a pair of brass rollers *kl*, acting against the limb of the instrument, give freedom to the motion of the telescope thus counterpoised, and complete the construction. The quadrant being thus put together, some strong but small plates of brass are made fast to its posterior face, and bent so as to fall into as many hold-fasts in the wall, into which they are respectively screwed; but the weight of the whole is supported chiefly by two pins or bolts inserted into the holes A and B, made in pieces of metal attached to such angular points of the iron bars, as

best support the centre of gravity of the whole: the pin A is made fast into the wall, but allows a motion round it, and the pin B fixes the quadrant after its extreme radii are adjusted, one horizontal, and the other vertical: this position was given by means of a plumb-line of fine silver-wire, that at first was so suspended as to bisect both the centre of the quadrantal arc and the point 90° on the limb, but which was transferred afterwards to an adjustable point of suspension out of the centre, with a corresponding dot made on the arc of excess of the limb. The plane of the quadrant was made vertical, as compared with the plumb-line, by the screws of the hold-fasts; and the telescope was adjusted parallel to this plane by comparison with a transit telescope viewing together both high and low stars in succession; but the line of collimation of the telescope could not be fixed properly, as it regarded the true horizontal line of the quadrant passing through its zero, without the aid of Graham's sector. This sector was, therefore, so adjusted to a star near the zenith, that it measured the same zenith-distance, with its plane turned to the east, as it did when turned to the west, and had its error ascertained in this way, and afterwards an altitude, taken with the quadrant, was made to correspond with such corrected altitude of a star taken with the rectified sector in reversed positions, which property the mural quadrant does not possess. The method of performing this adjustment for collimation will be understood from our directions hereafter given, when treating of *Ramsden's portable astronomical Quadrant*.

Bird's Mural Quadrant.—After the description we have given of Graham's mural quadrant, we shall have no occasion to dwell long on the structure of Bird's, which was made of brass entirely, after a similar model, but divided in both its arcs, of 90° , and of 96 grand parts, with more skill than Graham proved himself master of in this part of his labours. Smith and Stone describe Graham's quadrant as fixed to the east side of the pier at Greenwich, and looking to the south, which was the situation for taking meridian altitudes of the greatest number of stars; but since the year 1753, it has been placed on the west side, looking towards the north, and Bird's then took its original place.

This quadrant, which was procured in the time of Dr. Bradley, was first placed on the west side of the pier, in 1750; and the observations of himself and of Dr. Maskelyne, taken by it since it was placed on the east side, have contributed largely to complete the best catalogues of the heavenly bodies, which otherwise must have been very defective. While, however, Mr. Pond, the present astronomer royal, was engaged in making his well-known table of declinations, with one of Troughton's circles, at Westbury, he found reason to suspect the accuracy of the total arc of this quadrant, from a comparison of his own determinations with those previously made with Bird's quadrant; and a subsequent examination of the arc by Troughton justified his suspicion. With an apparatus expressly contrived for the occasion, this celebrated mathematical instrument-maker measured the total length of the quadrantal arc, and found it too small by $7''$, exclusive of another similar error of $2''$, occasioned by the wear of the axis of motion; though, on a rigid trial of the intermediate divisions, he did not detect more than *one second* of error, or rather of *inequality*, among the neighbouring divisions in any part of the arc. This trial was made in the presence of the present astronomer royal, in the year 1807; and the result, while it serves to correct past observations, by the addition of $1''$ to every successive 10° of altitude, would have tended to correct all future observations by a like addition, had not the large transit-circle, lately made and fixed in the same observatory by Troughton, superseded

superfeded the use of both the quadrants by its superior accuracy. The quadrantal arc of Graham's quadrant has not lately undergone a similar trial; but Troughton thinks it probable that the iron instrument has preserved its figure better than the brass one, and that consequently the addition of the brass arc on the face of the iron one has had no undue influence in altering either its temporary or permanent dimensions. At first, the telescope of Bird's quadrant was not braced; but after a trial, it was found to bend a little by a counterpoise of 80 pounds, and was afterwards braced by frame-work surrounding it, that prevented its yielding. A trial was made by Dr. Bradley of the total arc, in January 1753, after it had remained three years on the west side of the pillar; and though its weight is eight hundred pounds, the error was found to be not more than *two seconds*. He did the same again in July, in the year 1759, when it had remained six years and a half in its new situation, on the east side of the pillar, and found the arc exactly 90° . These examinations, having been made in the extremes of cold and heat, shew that change of temperature did not affect the total arc; and that, therefore, the 7" diminution of the arc, detected by Troughton, is occasioned by a change of figure in the space of 48 years. The difference of the readings of the two arcs has never yet amounted to 4", which is a standing proof of the accuracy and skill of Bird as a divider. Near the eye-piece of the telescope is a good micrometer, that not only gives slow motion in taking observations, but measures the number of *seconds* that the reading lines of the vernier is short of coincidence in any observation: and formerly the quantity indicated by the vernier had these seconds added, to obtain the whole measure; but, by Smeaton's advice, the vernier is now disregarded, and the addendum, obtained by several turns of the micrometer-screw alone, is used to complete the simple reading of the divisions and subdivisions, or 5' spaces; in other words, the screw, and not the vernier, subdivides the last 5' space in the observed arc, and gives what is due to the observation. The adjustments of this instrument, which was made of eight feet radius, on purpose to take the place of Graham's, are made in all respects as they are made in its predecessor; and the sector, which serves for adjusting Graham's line of collimation by stars near the zenith, is used for the same purpose in Bird's quadrant. If any of our readers wish to see the original plan of all the separate parts of Bird's quadrant, and to read his description of them, we beg leave to refer them to his quarto pamphlet, entitled "The Method of constructing Mural Quadrants," published by order of the commissioners of the Board of Longitude, in the year 1768. In this pamphlet, however, it is not mentioned that the vernier of the arc of 90° subdivides the space of 5' into ten parts of 30" each, by having ten divisions thereon, reading with eleven subdivisions of the limb; but we know that this was the original reading of the vernier.

Jeremiah Sisson's Mural Arc.—Perhaps it would have been more consonant to the order of time, if we had spoken of the younger Sisson, who was Bird's contemporary, and at one time his employer, next after Graham; but the histories of the two mural quadrants at Greenwich being connected, demanded that these instruments should follow each other in immediate succession. In the year 1768, Jeremiah Sisson, the son of Jonathan, made the large mural arc at the king's private observatory in Richmond gardens, which extends 45° , or more, beyond a quadrant, and consequently reaches beyond the north pole; which circumstance gives it the advantage of being put in the meridian, by an observation of the pole-star. The divisions of this arc are into degrees and its subdivisions, but the strokes are not cut

very neatly; and the reading, as was the case with Bird's quadrant at first, is performed partly by a vernier, and partly by a micrometer-screw. We have selected this instrument, as a specimen of Sisson's construction, principally on account of a power that it possesses, which is very important, but which probably was not contemplated, and consequently not intended by the maker himself: the extension of the divided limb, to several degrees beyond the north pole, affords the means of using this instrument in the manner that Troughton's large mural circle is now used, at Greenwich Observatory, by the present astronomer royal; namely, to measure the polar distances of the stars directly from the *true polar point*, without any reference to the latitude of the observatory, which method is one of the greatest modern improvements in making astronomical observations. It is much to be desired that this mural arc should be divided again by Troughton, or some other superior divider, and that it have microscopic micrometers applied to it, which may be placed by adjustment over any optional part of the divisions, and at any assumed distance from each other; for though it would not then, as it does not now, possess the valuable property of opposite readings, and of a motion in altitude to reverse the opposite arcs, by reason of its being less than a semicircle, yet being compactly made, and of large radius, it is capable of receiving divisions superior to those on the quadrants which we have just described; and as the situation and structure of the observatory are excellent, the appointment of a regular observer to co-operate with the astronomer royal would be highly conducive to the interests of astronomy. We hope that this hint may be taken up in a quarter where the power exists of realising our wishes in this respect. Astronomical clocks, and various other auxiliary instruments, are already in the observatory; so that the principal expence of instruments, as well as of an appropriate and elegant building, is already incurred.

Portable Astronomical Quadrant by Ramsden.—It frequently happens that superior artists vary the construction of their instruments to suit the views of the purchaser, or the scale on which they are to be constructed. We will select out of the quadrants made by the late ingenious Mr. Ramsden, that which he made for Dr. Shepherd for the observatory of Christ-college, Cambridge, and which professor Vince has described at considerable length in his "Treatise on Practical Astronomy." The figure exhibiting this quadrant is the 5th of *Plate XXIII.* of *Astronomical Instruments*, which requires but little explanation. The tripod on which the quadrant is mounted has screws of adjustment to set the stem, on which the horizontal motion is performed, perpendicular, which is proved to be so in all directions when the plumb-line bisects both the superior and inferior dots during the whole revolution round a horizontal circle. The visible stem is a brass tube, and through it ascends a solid steel vertical axis, which fitting closely at the superior and inferior ends, has not the least shake, and preserves the position once given it so long as the feet screws are unmoiled. The telescope is of the achromatic construction, and has the usual apparatus for slow motion, the screw of which is made a micrometer to subdivide the small residuum of the angle that the vernier alone will not indicate, when the coincidence is not perfect. The telescope lies on a bar that carries the counterpoise, and in which is the centre of its motion. It has a system of wires in the focus of the eye-glass, which are adjustable by screws, both upwards and sideways, as well as in a circular direction, so that the adjustments for collimation, and for zero in the altitude circle, may be effected thereby. The point of suspension of the plumb-line is also adjustable by a proper screw apparatus.

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apparatus. At the top of the vertical tube, or stem, is a small horizontal circle with a clamping apparatus for flow horizontal motion, by means of which the whole quadrant, with its attached telescope, turns gradually round in azimuth. When observations are made in or near the zenith, the plumb-line falls in the way of the telescope, and is obliged to be removed, on which account the large quadrant made by Ramden for the duke of Marlborough, and now placed at Blenheim, has the plumb-line suspended at the posterior face of the instrument. This inconvenience is, however, remedied by the addition of a spirit-level suspended from an adjustable horizontal brass rod, under the uppermost radial bar of the quadrant, and this level not only supplies the place of the plumb-line when taken off, but at all times serves as a check on its adjustment, and, when furnished with a graduated scale, may very well be made its substitute. The construction of Ramden's portable quadrant was probably borrowed from Bird's, as well as his method of dividing the larger instruments that exceeded the reach of his dividing engine; but the instrument before us has no other horizontal or azimuth circle, except what is used plain, for the purpose of giving flow motion. Neither is there a second horizontal telescope fixed permanently in that situation by which the telescope of observation may have its collimation determined, and the zero of its vernier adjusted.

The vernier of this quadrant reads with two sets of divisions, like that of the mural quadrant by Bird, but the radius being small, the subdivisions are made into four parts

each; the inner arc is divided into 90°, and the subdivisions into 15' each, but the outer one into 96 parts, or grand divisions, and these again each into four parts, or subdivisions; and those two arcs operate as a check on each other. The micrometer sub-divides the 15' into 3"; but it is necessary to convert the reading of the arc of 96 grand divisions into a corresponding quantity, expressed in degrees, minutes, and seconds, which may be done by direct proportion, or, which is more feasible, by a table that we have subjoined, calculated for this purpose. The readings of the arc of 96 are put down with titles *divisions*, *sub-divisions*, and *vernier*, where 16 (and sometimes 32) on the vernier are equal to one sub-division, and four sub-divisions to one division; for example, suppose the reading to be thus, 21 div. 2 sub. 11 ver. we shall have from the table

Divisions	21	=	19° 41' 15"
Sub-divisions	2	=	28 7.5
Vernier	$\frac{1}{4}$	=	9 40.1
Total			20 19 2.6

When, however, the coincidence of the vernier is not perfect, the quantity brought up by the micrometer-screw must be added as a fractional portion of 52".8, which is the value of one step of the vernier, when 16 is the number of steps, but if 32 are inserted, then 26".4 would be the value of one step forwards from zero.

A TABLE for the Reduction of the Grand Divisions, Sub-divisions, and Vernier, of the Arc of 96, into Degrees, Minutes, and Seconds.

Grand Divisions.						Sub-divisions.			Vernier.			
	°	'	"		°	'	"		°	'	"	
1	0	56	15	33	30	56	15	1	14	3.7		
2	1	52	30	34	31	52	30	2	28	7.5		
3	2	48	45	35	32	48	45	3	42	11.2		
4	3	45	0	36	33	45	0					
5	4	41	15	37	34	41	15					
6	5	37	30	38	35	37	30					
7	6	33	45	39	36	33	45					
8	7	30	0	40	37	30	0					
9	8	26	15	41	38	26	15					
10	9	22	30	42	39	22	30					
11	10	18	45	43	40	18	45					
12	11	15	0	44	41	15	0					
13	12	11	15	45	42	11	15					
14	13	7	30	46	43	7	30					
15	14	3	45	47	44	3	45					
16	15	0	0	48	45	0	0					
17	15	56	15	49	45	56	15					
18	16	52	30	50	46	52	30					
19	17	48	45	51	47	48	45					
20	18	45	0	52	48	45	0					
21	19	41	15	53	49	41	15					
22	20	37	30	54	50	37	30					
23	21	33	45	55	51	33	45					
24	22	30	0	56	52	30	0					
25	23	26	15	57	53	26	15					
26	24	22	30	58	54	22	30					
27	25	18	45	59	55	18	45					
28	26	15	0	60	56	15	0					
29	27	11	15	61	57	11	15					
30	28	7	30	62	58	7	30					
31	29	3	45	63	59	3	45					
32	30	0	0	64	60	0	0					

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Adjustments.—1. To adjust the axis of the pedestal vertical.—

This adjustment may be performed either by the *plumb-line* or by the *level*, both which methods we will explain in succession. We have already said that when the wire of the plumb-line will continue to bisect both the upper and lower dot, while the instrument is turned quite round in azimuth, its axis is vertical in all directions, but this could not be effected unless the plumb-line passing through the two dots were also parallel to the axis; this adjustment, therefore, is made partly by the screws at the feet of the tripod, and partly by the screw that moves the piece bearing the upper dot in a lateral direction. In the first place then turn the quadrant in azimuth till its plane, or, which is the same thing, the telescope lies parallel to a line joining any two of the three feet, and turn one of these two screws till the wire bisects the lower dot, and with the proper screw bring the upper dot to the same wire; then reverse the telescope by turning 180° in azimuth, and if both dots are again bisected, the axis is vertical in the direction that the telescope has pointed; in the next place turn the telescope the space of a quadrant till it points in the same direction as the third foot of the tripod, and make the wire bisect the lower dot by the screw of this foot, and it will be found to bisect the upper dot also, if the first adjustment of the dot was properly made, but if not, repeat the operation till both dots are bisected in all the reversed situations of the telescope, and then the axis will be vertical in every direction.

In making this adjustment by the level alone, the process must be thus; first, the level must be made parallel to the rod on which it hangs, and secondly, this rod must be put perfectly horizontal, and the level will then be horizontal also, with the bubble in the middle. In order to make the level parallel to the rod, place it parallel to a line joining two of the feet screws, and bring the bubble to the middle by one of the feet screws in question; then take off and reverse the position of the level, and if the bubble is found in the middle now, the parallelism is perfect, if not, one half of the error must be rectified by the same foot-screw, and the other half by the adjusting screws at the end of the rod, by releasing one and screwing up the other. A repetition or two of this process will make the bubble stand in the middle in both of the reversed situations. In the next place, with the level thus parallel to the rod of suspension, turn the quadrant round its axis an entire semicircle as nearly as can be estimated, and if the bubble will now rest in the middle, the rod is level, and being at right angles with the axis of the quadrant's motion, proves that this axis is vertical in every direction; but if the bubble is found to run to one end of the tube, bring it one half way back by the rod's adjusting screws, releasing one and fixing the other, as the case may be, and the other half by the proper foot-screw. A repetition of this process will soon settle the bubble in the middle during a whole revolution in azimuth, and then the adjustment of the axis is perfect, as well as of the rod and level.

2. The second adjustment is that by which the *line of collimation* of the telescope is made parallel to the horizontal line that passes from the centre of the quadrant to zero on the limb, or quadrantal arc, at the same time that zero on the vernier coincides with zero on the limb. This important adjustment may be made in several ways, some of which are tedious and otherwise objectionable; but we will confine ourselves to two which apply, one to the vertical, and the other to the horizontal line of the quadrant, which two methods, when duly effected, will not only check each other, but detect the error of the *total arc*, if there is any, at the same time; which is an acquisition of the utmost importance. First then, to adjust by the vertical line, let the

axis of the quadrant be first made truly perpendicular in all directions by the adjustment we have already described, and fix on a star within a few degrees of the zenith, when exactly on the meridian, and measure its altitude by the cross-wire in the field of view in the usual way, and note down the result; do the same on a successive night soon after, if possible on an evening of similar temperature, with the quadrant turned half round in azimuth, and note again the result; if these readings prove to be at equal distances from the point 90° , one on the quadrantal arc, and the other on the arc of *excess* beyond 90° , the horizontal wire is truly placed in the eye-piece, but if not, *half* of the difference of the readings must be corrected by the proper screw for raising or lowering the said wire. This may be done by directing the telescope to a distant mark till the cross-wire bisects it, then by moving the screw of slow motion of the vernier the *half quantity* required, and by bringing back (up or down) the cross-wire thus displaced to its original mark again. This operation repeated will place the cross-wire in such situation, that zero on the vernier will be in its proper place with respect to the point 90° ; or the *half difference* thus ascertained may remain, without altering the cross-wire, as an *error of adjustment* to be constantly applied with the sign + or —, as the case may be, in all subsequent observations. Again, to adjust by the horizontal line passing through zero of the quadrantal arc, it will be necessary to have a second telescope turning on pivots in adjustable Ys attached to the back of the quadrant, on the same level with the said horizontal line of the quadrant. This telescope may be called the *adjusting telescope*, and may be also used to *watch* a distant mark, before and after an altitude is taken, in order to detect any deviation in the position of the vertical axis, that may happen during the operation of measuring. Let the adjusting telescope bisect a fine distant mark with its cross-wire, and turn the tube of the telescope round one half way on its pivots, as it lies in a horizontal position, and if the wire now bisects the same mark it is truly fixed, if not, look out for a new mark a little higher or lower, as the case may be, and make it cut that in the reversed positions of the cross-wire, by means of the proper screw for this purpose; now this adjusting telescope will be adjusted for collimation: in the next place, put zero on the vernier to zero on the limb, and direct the telescope of observation to the same distant mark, by which the adjusting telescope had its wire adjusted, and let this mark be bisected by both telescopes, the level and plumb-line at the same time shewing that the vertical axis is perpendicular; now turn the quadrant half round in azimuth, and reverse the adjusting telescope so as to view the same distant mark again, and if it is found to bisect it as before, the horizontal line of the quadrant is right, and also the quadrantal arc without error, supposing the telescope of observation to have its adjustment for collimation as fixed by the point 90° , above described; but if this adjustment of the point zero on the limb be *first made*, half the apparent error must be rectified by the screw at the eye-piece, by means of reversed positions and new marks; and then afterwards the adjustment by a star near the zenith will detect the error of the whole arc. If, however, no error in the total arc exists, then the adjustment for collimation may be made either from the horizontal or from the vertical measurement, as may be most convenient; one of which is more practicable by day, and the other by night. When this delicate and very essential adjustment is finally settled, the object-glasses of the telescope should not be disturbed, and therefore it would be advisable to have its interior surface well cleaned previously.

It was taken for granted that the cross-wire was perfectly horizontal

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horizontal during the time the preceding adjustment was made, or, which is the same thing, that the parallel vertical wires were perpendicular to the horizon. This is proved in a simple manner thus; direct the telescope to a fine small distant mark, and make the adjustment for vision, if necessary; then if one of the vertical wires will continue to bisect the said mark through the whole field of view while the telescope is elevated or depressed, the wires are right, but if not, they must be made so by the proper screws for that purpose, near the focus of the eye-glass. This preparation ought to precede the last adjustment, and when once made, seldom requires altering, except in case of accidental injury.

It has also been assumed in the preceding adjustment, that the maker of the instrument placed the plane of the quadrant parallel to the axis of its motion, and also the line of collimation of the telescope parallel to the said plane. The former may be known to be true thus; if, when the plumb-line is adjusted, at its centre of suspension, just to escape touching the limb, (which should always be the case,) the quadrant's motion in azimuth will not alter it in this respect, the plane is truly fixed; but if not, the screws, that fix the quadrant to its axis, must be resorted to for the alteration, which is best done by the maker. When there is no plumb-line, a small spirit-level, fixed at right angles to the plane of the quadrant, will answer the same purpose; for the resting of the bubble during the quadrant's revolution in azimuth, will be a proof that the plane to which it is at right angles is vertical. With respect to the parallel position of the telescope, as this is guided by the vernier sliding on the limb, it is the business of the maker to adjust it properly, which he will best do by a comparison with a good transit instrument of the passages of a high and of a low star in each of the two instruments; but a small deviation of the telescope with respect to parallelism, though to be avoided if practicable, will not sensibly affect the measurement of altitudes, which is the sole business of this instrument. If, however, this deviation is considerable, the eye-end of the telescope must be set nearer to or farther from the limb, as the case may be, by the maker himself. We have been the more minute in describing these adjustments, not only because they are indispensably necessary in making good observations, but because they will apply, one or other of them, by means of the plumb-line, or of the spirit-level, to all other astronomical quadrants that have a motion in azimuth.

We have before us the drawing of a large and beautiful quadrant made by Mr. Cary, for Leopold, the late grand duke of Tuscany, with two telescopes and a graduated azimuth circle, but the description we have given of Ramsden's instrument will equally apply to his, except as to the dimensions.

Portable Astronomical Quadrant by Troughton.—Though we have described Ramsden's portable astronomical quadrant with much minuteness, and have detailed the most useful methods of making such adjustments as will apply to the other portable quadrants that have a motion in azimuth, yet we should do violence to our own feelings, as well as to the ingenuity of an existing artist of the first eminence, if we withheld from the public eye the great improvements that he has made in this instrument since the death of Ramsden. Fig. 6. of the same plate that contains Ramsden's instrument, is a reduced perspective view of the improved astronomical quadrant of Troughton, which was made by him and sent to Bilboa in Spain, about the time that astronomical circles began to be constructed. It has been asserted, under our article CIRCLE, that this instrument, as constructed by Troughton, (and we may now add, by Thomas Jones, who has learnt his mode of dividing,) is greatly superior to any

quadrant that can be made, on account of properties which the circle exclusively possesses; but so far as a quadrant's accuracy can be depended on, Troughton's improved construction is to be preferred to all others. And, indeed, when we consider that simplicity, steadiness of performance, and permanence of the adjustments once made in this instrument, are properties which it peculiarly possesses, along with comparative cheapness, it is probable that there will always be purchasers, when such an instrument is on sale, provided the improver will consent to make such instrument with limited powers, when he can have rapid sale for those which he now constructs, with all the advantages that the circle affords.

The radius of this quadrant is three feet, and the body is made double, that is, of two quadrantal frames united into one, by small pillars holding their planes parallel, and enforcing the two properties, not often united in other men's instruments, of lightness and strength at the same time. The tripod, on which the quadrant is supported, is a frame of mahogany, braced in different directions, so as to resist any ordinary pressure, when the quadrant is put in motion, or the telescope used. The three feet-screws are furnished with each a Hooke's joint and long handle, so that the observer may make an adjustment with any of these screws without stooping, and consequently without withdrawing his attention from the plumb-line apparatus, or spirit-level, that indicate the quantity of adjustment that may be necessary from any individual screw. About the middle of this pedestal, or frame-work of the tripod, is a three-armed horizontal bracing piece, on which the stem of the quadrant rests; and this stem is kept vertical by a socket of brass made fast to the centre of the table, that surmounts the pedestal, in which socket the vertical axis turns both steadily and freely, while it rests on the three-armed bracing piece below. The azimuth or horizontal circle is centered on this axis, but so as to admit of a motion round it of about two degrees, for the purpose of putting the zero of the quadrant right when the telescope is in the plane of the meridian. This small motion is produced by the tangent screw seen in front, and the other tangent screw regulates the slow motion of the telescope and vernier, by taking hold of the solid vernier plate, that reads at opposite points, and that may be clamped, when in use, to the azimuth circle, which is also a solid circular plate of brass, subdivided into 10' spaces, and reading by the verniers alone to 10".

The vernier or index-plate is of considerable depth, and hollow, terminating with a chamfered edge below, and contains in it a triangular frame not seen, soldered to it, and opposed, for the sake of strength, by another similar frame seen above its plane. From the frame within the hollow index-plate arise three small pillars, which support the upper triangular frame at the three corners, and passing through it receive so many milled nuts on their tapped ends, by which means the whole are compactly united. These milled nuts are useful for adjusting the plane of the quadrant parallel to the vertical axis of the quadrant's motion in azimuth; and it is here where the quadrant is to be separated from the stand for close package. Upon the upper triangular frame is soldered fast a short but strong conical tube, that supports the long column that terminates with a supplementary cone. From nearly the lower extremity of this long column a couple of braces ascend about twenty inches to the upper part of the body of the quadrant, and, by being made fast to it, complete the steadiness of the structure in an admirable manner. The telescope, which is about forty-two inches long, and achromatic, as well as furnished with an adjustable system of Spider's threads, tapers from the object-glass down-

downwards, to prevent any inclination to bending by its weight, and has an axis of motion of four inches and a half long, that passes through the thick pillar, that connects the two quadrantal portions of the double frame at the exact centre of motion, and of the divided arc. The counterpoise is applied at the redundant end of the telescope, and the vernier borne by its end, near the eye-piece, divides the 5' spaces of the vertical arc into 5", while a micrometrical microscope, attached to the metal of the telescope, subdivides this last quantity into *single seconds*. A nicely ground spirit-level hangs on the horizontal bar, with its proper adjustment apparatus, which alone will ascertain the position of the quadrant to a *second*; but, as if this were not sufficient, a plumb-line is made to descend, free from dult, or agitation by the wind, from an adjustable point of suspension through the hollow column, where there is little or no disturbance from a motion in azimuth, and ensures the position still more certainly. The water vessel in which the plummet is immersed, to prevent vibration, is contained in the hollow short cone before described, as containing a triangular frame within it, and the situation of the wire is examined in two directions, at right angles to each other, by microscopes looking across the bore of the column, at a convenient height for the observer to see without a change of position of his body, when he has been just observing at the telescope. The mark used for each wire to bisect is a luminous disc, known by the name of *Ramsden's ghost*, from its being only the *image* of a luminous point without substance, occasioned by a contracted aperture of a tube, fixed at the remote side of the column into which light enters, and by which it is directed without parallax. Besides these appendages, there is a secondary or adjusting telescope, such as the elder Siffon made for his spirit-level, and such as we have already described, as furnishing the means of adjusting the horizontal line of a quadrant that moves in azimuth, and of ascertaining the error of the whole quadrantal arc, by comparison with the adjustment by a star near the zenith. (See *Portable Astronomical Quadrant by Ramsden*, before described.) Lastly, the radial bars that bear the quadrantal arc, taper downwards from the centre, thereby giving strength to the part most liable to alter its figure by weight, as it is supposed Bird's mural quadrant has done in a small degree for want of such precaution. This quadrant has an arc of excess at each end, and is capable of all the adjustments we have above described in an exquisite degree.

Of Nautical Quadrants, measuring by Reflection.

Sir Isaac Newton's reflecting Quadrant.—A manuscript account of a quadrant, measuring altitudes and distances by reflection, of the hand-writing of sir Isaac Newton, was found among the papers of Dr. Halley after his death, which quadrant, according to Stone, was actually made in the year 1672, when Dr. Halley was preparing to go to the South seas, to make an addition to his catalogue of fixed stars; but the manuscript account was not produced, or even mentioned, when Hadley's instrument was shewn to the Royal society, nor was made known till the year 1742. (See *Phil. Trans.* N° 465.) Hence some doubt has been entertained whether sir Isaac Newton or Hadley was the first inventor of the reflecting quadrant. The most probable inference is, that each invented his own, seeing that though the principle is the same in both constructions, yet the mode of applying it is different, as will be seen from a comparison of the figures, and from our description of each in succession. Sir Isaac Newton's quadrant was preserved for several years at the house of Mr. Heath, who was a mathematical instrument maker in the Strand, London, and it is probably

in existence at this time. Dr. Hooke is also said, by Dr. Pratt, to have invented a quadrant that was, or might be, used at sea with one reflection only; and, indeed, he is asserted to have been the first man who proposed the use of a *mirror* in a nautical instrument. See *CIRCLE*.

Sir Isaac Newton's quadrant, represented by *fig. 7. of Plate I. of Astronomical Instruments*, consists of an entire sectoral plate of brass, P Q R S, to the plane of which the telescope A B is fixed and lies parallel, and an index, which is moveable about an axis of motion at A. The limb D Q was accurately divided into half degrees, and, as is said, half minutes, on a scale of four feet radius, and was subdivided by a diagonal scale into $\frac{1}{2}$ th of a minute. The principle on which this semi-division is founded is this; *viz.* "If a fixed ray of light be reflected at a plane reflector, and if the reflector be made to revolve about an axis perpendicular to the plane passing through the incident and reflected rays, which may be called the plane of reflection, the angular velocity of the reflected ray will be *double* to the angular velocity of the reflector." See *Vince's Practical Astronomy*, p. 7, &c.

Hence one small mirror, G, is made fast to the plane of the sectoral plate, and perpendicular thereto, but inclined in an angle of 45° to the axis, or length of the telescope, and in such a way, as to cover one half of the aperture, while another similar mirror is borne by the index, in such a position, that when the index is at zero, both the mirrors are not only perpendicular to the plane of the quadrant, or rather octant, but are parallel to each other. Now, according to the principle that we have just mentioned, when the index is moved forward, a ray of light from any fixed luminous body, when caught by the index mirror, will be reflected on the fixed mirror, and an eye directed through the fixed telescope towards the said body, will see it divide into two bodies the instant that the index begins to move; that is, the body itself will be seen *stationary* through one half of the telescope's aperture, and its *image* will be seen in the other half *in motion*, and this motion has double the velocity that the index has, which bears the revolving reflector; and on this account it is, that the divisions for half degrees and half minutes, are read as whole degrees and whole minutes, as well as the $\frac{1}{2}$ th read as $\frac{1}{4}$ th by the diagonal scale. From this short explanation of the principle and structure of sir Isaac Newton's reflecting quadrant, it is easy to perceive that the construction is derived immediately from the principle in the simplest, though in practice not the best manner; for the instrument itself illustrates the principle in the most obvious way; but, from its magnitude and mode of being used, it is very inconvenient to be supported without a stand, which on board a ship is inadmissible.

Perhaps it might be on this account that Dr. Halley did not pay more attention to it than he appears to have done, according to the information that we at this distance of time possess. However, it is evident, that the instrument before us is capable of measuring either vertical, horizontal, or oblique angles, in the way it professes.

Cole's Quadrant by single Reflection.—*Fig. 2. of Plate XXIII. of Astronomical Instruments*, is the figure of an instrument, which, like Dr. Hooke's contrivance, measured altitudes by single reflection, as we conceive, the drawing having fallen into our hands without the description. An arc composed of an entire quadrant, and an index with a single mirror fixed to it at its centre of motion, constitute its leading features, while a sight-vane, at the remote end of the prolonged index, instead of a telescope, has a plane hole, through which the sun is viewed after reflection from the index-glass, his rays having first passed through a coloured glass.

glafs. This construction, with the addition of sir Isaac Newton's second mirror, would constitute an union of two instruments, that would greatly resemble the combination adopted by Mr. Hadley, which follows next in our list of quadrants; but which may not have been copied from such union; for Cole has got the vernier scale, which is preferable to the diagonal one adopted by Hadley, and therefore probably he followed Hadley, though the quadrant before us has not recommended itself to general use, as being an improvement.

Hadley's Quadrant.—As we cannot help considering Hadley's quadrant, or more properly *octant*, as a near relative at least to his friend sir Isaac Newton's, we will describe it next in order, while the principle of its construction is fresh in the reader's memory. The circumstance of Mr. Hadley's being president of the Royal Society was favourable to the early notice of his instrument; and the interest that the British nation took, and must ever take, from its insular situation, in nautical improvements, contributed to its early adoption, at a time when such an instrument was greatly wanted.

Mr. Hadley, we learn, tried various modifications in the construction, but that which has been approved from long usage is the one we shall select for description. Fig. 1. in Plate XXIII. of *Astronomical Instruments*, is the representation of Hadley's octant, as it is now constructed with a vernier, which it had not at first, and which is preferable to the diagonal divisions at first applied by Hadley, as well as by sir Isaac Newton. For the sake of lightness, united with strength, the frame of the instrument, when made of any of the hard woods, is put together usually as is represented in the figure, but when made all in brass, and particularly when the limb is extended to 120 half degrees, reading as 120°, in which case it is called a *sextant*, the best modern makers make it double; that is, have two separate light frames, united by short pillars, standing at right angles to their planes, which thus become parallel. This construction, we believe, was introduced by Mr. Troughton, and allows a more steady motion to all the moveable and adjustable parts, by lengthening their axes of motion, which penetrate across both parts of the double frame, and by that contrivance have longer bearings. But we are now proposing to describe a quadrant of Hadley's own construction. A B C is a frame of some hard wood, such as ebony, which may be of any convenient radius, from eighteen inches downwards to three, or less, if required for the pocket, and A D is the index bearing the vernier at D, together with the usual clamping apparatus for slow motion, in making the contact in any observation. This apparatus, together with the powers of the vernier, and mode of using it, have been explained under our article CIRCLE, (see also *VERNIER*,) and therefore may be referred to by the reader unacquainted with their uses. When the radius is very small, the vernier subdivides half degrees, and has thirty divisions on it, but has twenty or fifteen, accordingly as the degree of the limb is subdivided into *thirds* or *fourths* of a degree. The peculiar excellence of this instrument, either in the form of an octant or sextant, is, that all sorts of angles can be measured with it on board a ship, even while the ship is tossed by the waves; and also, that it requires no other auxiliary means, than the natural horizon, which at sea is always, or mostly present, when a heavenly body can be seen. The plumb-line and spirit-level are equally dispensed with: to which may be added, that, if any accidental injury be received, a circumstance not improbable in the hands of sailors, the adjustments are so simple, that, generally speaking, the derangements may be easily rectified. In the best instruments, a small telescope is

serewed into the sight-vane, which not only prevents parallax, by limiting the line of sight between two parallel wires, but assists the sight greatly in obtaining exact contacts. There is usually an arc of excess at each end of the limb, one of which is useful in adjusting the index-error by the sun or moon, and the other is serviceable when angular distances are measured beyond a quadrantal arc; indeed it would be well if the arc were always extended to measure 120°, or more, for then a sextant would be competent to measure all sorts of angles that the mariner can require, to find his latitude, time, and longitude.

When the octant has not the tangent screw of slow motion for adjustment in making the contact, the index is nicely moved by hand, and then fixed by a screw behind it for this purpose, and in either case the examination and noting down of the altitude, or horizontal angle taken, may be read at any time, for hours afterwards, which is another important advantage that this instrument possesses in common with the sextant; for where more observers than two are not present, one observer may thus manage to take both an altitude and a distance in a lunar observation with two separate instruments in quick succession, while another observer is taking the altitude of the second object; or with the help of Margett's horary tables, the second altitude may be had by inspection, when the hour, latitude, and declination of the body are known, in which case *one observer* can take a lunar observation with tolerable accuracy. The limb of the instrument is best of metal, such as brass, silver, or platinum, when made and divided in the best way by a superior dividing engine, such as Troughton's; but in ordinary instruments a piece of ivory is frequently let into the wood, and sometimes the divisions are made even on the wood itself, which is liable to be affected by moisture. The index is most frequently entirely of brass, and wider as it ascends to the centre of motion, to prevent lateral bending, which would destroy the accuracy of the readings. When an observation is made by the larger sort, the right hand should be applied to the lower extremity of the index to give it steady motion, while the left holds the lower end of the remote radial bar; and the plane of the instrument must be kept in the line that joins the two objects, of which the horizon is one, when an altitude is taken, and then the instrument is held vertical. In bringing down the image of an object to the horizon by a *fore* observation, the body of the observer must gradually incline towards the horizon, and a little vibrating motion will assist in determining the exact plane of contact; but in taking a horizontal angle, the observer will handle the instrument as best suits his convenience. The mirror at A is placed over the centre of motion of the index, in a direction pointing to zero on the vernier, and perpendicular to the flat face of the index: this index-glass, being completely silvered, reflects the light it receives directly at right angles on the glass E, when the zero of the vernier is at the zero of the limb; but as the limb proceeds forwards, this angle alters, and, as we have said, is *double* of the measure of the real angle to be measured and indicated. This glass E is also fixed perpendicular, and has screws of adjustment for perpendicularity above its socket of brass, and a tail-piece with a fixing-screw behind the frame, for fixing the parallelism; the want of which is called the *index-error*: one half only of this glass, which is called the *fore-horizon* glass, is silvered, and the other half remains unsilvered, in order that both the direct rays transmitted through the unsilvered part, and the reflected rays coming from the silvered part, may meet at the eye, on which account the middle of this glass, where the line of separation crosses, is the part to be viewed

viewed in making a contact, otherwise both the image of one object, and the substance of the other, could not be seen at the same instant. F is the sight-vane, with two holes, usually an upper and a lower, inserted into the first radial bar of the frame, so that the holes are at the same distance from the plane of the instrument as the line of separation is in the half-silvered glass E, to prevent parallax of the reflected rays, and in the best instruments this vane, with its telescope, has an adjustable motion to and from the plane, in order that more or less light may fall on either of the bodies observed, which is not only useful, but necessary, in taking a lunar distance; for by this adjustment the image of one body may be made as luminous as the real body of the other, by increasing the light of one, while it decreases that of the other; that is, by making more of the silvered, or of the unsilvered part of glass E, fall before the object-glasses of the small telescope, when this adjustment is necessary. It may be necessary to observe here, that every silvered glass of sensible thickness has two reflections, one on the anterior, and the other, which is the principal one, on the posterior or silvered face, and in many cases errors may be occasioned by these double reflections; to remedy which, Dr. Maskelyne proposed, that the silvered portion of the posterior face should be ground rough and painted black, taking care that the grinding be so performed, that the line of separation between the polished and unpolished parts be parallel to the plane of the octant. In the *back* horizon-glass, which is that seen with its sight-vane at G, with adjustments similar to those of the *fore* horizon-glass at E, the whole posterior face is silvered, except a slit, that divides it in a line parallel to the plane of the frame, through which slit the body is observed in a back observation. But when the sun is the body observed, his light is generally too intense for the eye to bear, particularly when the small telescope is used; to render the rays tolerable to the eye, a coloured glass, or glasses, must be interposed, and a blank tube instead of a telescope be used, by which means the sun may be viewed without doing injury to the eye; and usually a system of coloured glasses are slid into a square hole, as at H, and a joint in each allows them, or any one of them, to be brought forwards into the situation where the direct rays must pass to the eye. The same remedy is also sometimes applied at the eye-piece of the blank tube, when the sun alone is observed. The plane of the back horizon-glass is placed not only parallel to the plane of the frame, but at right angles to the plane of the fore horizon-glass, in order that the same readings may apply in both kinds of observation, and this object was effected by the maker by the simple rectangular position of the two horizon glasses to each other, and by reversing the position of the body in making a back observation; for as the inclination of the index-glass to the fore horizon-glass gives *double* the angle directly measured; so *twice* the complement of this inclination to the back horizon-glass gives the same quantity, and on the same part of the graduated limb, when measured in a reversed position.

Adjustments.—The adjustments of every instrument are of the utmost importance to the accuracy of observations taken thereby, but they are particularly so in the instrument before us, because a small deviation from parallelism in the fore horizon-glass, or from perpendicularity in the back horizon-glass, as compared with the index-glass, (with the vernier at zero of the limb,) will *double* the error occasioned by it in the quiescent situation, as soon as motion is given to the index-glass. 1. The first adjustment is, *to set the index-glass perpendicular to the plane of the instrument*: this is done by first sliding the index to about 40° or 45° of the

limb, while the octant is held with its plane nearly parallel to the horizon, then a glance into the index-glass will shew, whether the sharp edge of the limb seen by reflection, is an exact and straight continuation of the same edge of the limb seen by direct vision, and if this is not the case, it must be made so by the screws that adjust the bed of the mirror; and in all cases where two screws are to be used, one must be released as much as the other is screwed inwards. Dr. Mackay proposes to place two small pieces of metal as adjusting tools, with each a horizontal line drawn on it, at equal heights from the plane of the limb, at some distance from each other, so that the horizontal line of one may be a continuation of the horizontal line of the other, when one is viewed by reflection, and the other by direct vision, but the sharp edge of the inner part of the limb will answer all ordinary purposes. 2. The second adjustment is, *to set the fore horizon-glass perpendicular to the plane of the instrument*: this is done by first fixing the zero of the vernier at zero on the limb, and while the plane of the frame is held parallel to the horizon, by applying the eye to the lower hole of its sight-vane; then if the horizon, or any distant horizontal line, appear to be a straight line, the glass is placed perpendicular already; but if the parts seen by reflection and by direct vision do not constitute a straight line, they must be made to do so by the screws at the bed of the glass, one or other of which must be screwed in, as the fracture of the line demands; that is, if the line seen by reflection appear *above* that seen by direct vision, that screw must be urged *inwards* which is on the *farther* glass, and *vice versa*, until the fractured line be straight. 3. The third adjustment is, *to rectify for the index-error* of the fore horizon-glass, or to place it parallel to the index-glass, when the zero of the vernier is placed at zero on the limb. To do this properly, a bright distant object must be chosen, such as the sun, moon, or star, and while the zeros coincide, look through the vane, or telescope, and observe if the body and its image coincide; that is, if the image is invisible: in this case, the fore horizon-glass is parallel to the index-glass, or is truly adjusted; but if not, release the tail-piece or lever behind this horizon-glass, and with the thumb-piece give it a small motion, till the body and its image coincide, in which situation it must be fixed by the fixing nut before released. Sometimes the act of screwing will displace in some degree the tail-piece, and thereby again occasion a sensible index-error. When this cannot be completely avoided, the error must be ascertained and allowed for with its sign + or — in every subsequent observation, while it remains unaltered. This error may be ascertained by measuring the diameter of the sun, first forwards on the limb, and then backwards on the arc of excess, and one half of the difference of the measures will be the *index-error* + or —, as the case may be. 4. The fourth adjustment is, *to set the back horizon-glass perpendicular to the plane of the instrument*: this adjustment is similar to the second, and may be performed by the directions there given, supposing them to be for the back horizon-glass and its vane, instead of the fore horizon-glass. 5. The fifth and last adjustment is, *to set the back horizon-glass perpendicular to the plane of the index-glass produced, the zero of the vernier being placed at zero on the limb*: this adjustment at sea is performed thus; let the vernier be put as much to the right of zero, as is equal to twice the dip of the horizon, in the situation where the observer stands, then hold the quadrant in a vertical position, and apply the eye to the back-horizon vane: now, if the horizon seen by reflection happen to coincide with that seen by direct vision, the glass is already right; but if not, the lever or tail-piece behind the frame at this place must be released by the proper fixing screw,

screw, and turned slowly by the thumb-screw or nut, till this coincidence is perfect, and then the lever must be made fast again; the reflected horizon will be inverted when viewed in the manner here described. When the instrument is used in a back observation on the land, which is not likely to happen often, the adjustment will require some artificial aid: by Dollond's method, an index is applied to the back horizon-glass, by which it may be put parallel to the fore horizon-glass, by the third adjustment applied thereto, and then, by a graduated arc of 90° , inserted on purpose, the index of the back horizon-glass is set perpendicular to its former situation, and consequently is made perpendicular to the plane of the fore horizon-glass. By Mr. Blair's method, the under edge of the index-glass is ground and polished, so as to be at right angles to the plane of the glass, and hence the back horizon-glass is adjusted, by making the direct and reflected horizons agree, while the vernier stands at zero on the limb, exactly as is done in the third adjustment. But we are to suppose the instrument not furnished with either of the above named auxiliary means; when this is the case, a long level space must be chosen in some common or park, where three stakes can be put up in the same straight line exactly, and at an interval from each other of not less than 500 yards, but if 600 or 700 the better; then, the vernier being truly placed at zero, let the plane of the octant be held horizontally with its back horizon-glass exactly on the top of the middle staff, and let one of the rods be viewed directly through the back sight-vane, then if the other rod, seen by reflection, coincide with it, the position of the back horizon-glass is true, but if not, it must be made so, by the tail-piece behind, as before directed; if in fixing the tail-piece a derangement should take place, which cannot be *exactly* done away by a second or third trial, then the index-error for the back observation must be ascertained.

This error may be obtained by reversed observations by two methods; thus, let the coincidence of the two extreme stakes be made from the middle staff as just directed, by a motion of the vernier, instead of the tail-piece of the back horizon-glass, and read the quantity moved forwards or backwards; then turn the downward face of the frame upwards, and repeat the operation, and read again; now, if these two readings are found to be one on the limb, and the other on the arc of excess, half of their difference will be the error sought, + or -; but if they both are read on the same side of zero, half their sum, + or -, will be the error; when they are both read on the limb, or if the greater quantity be read on the limb, when the less is on the arc of excess, the sign will be -, and *vice versa*. By the second method, instead of reversing the plane of the instrument, let the observer reverse his position, making the right-hand staff to be the left-hand one, and *vice versa*, and then let him repeat his first observation, with the same face of his instrument up that he had in that, and the same result will follow, that was obtained by reversing the plane of the instrument. These two modes of obtaining the error in question, by reversed observations, may be made to check each other, and will then give an average of the two results, for the error to be applied to each subsequent observation, taken with the back horizon-glass in its last determined position.

Examination of the Instrument.—These several adjustments being finished, the observer might proceed to make his observations, provided he could rely on the skill and credit of the maker of his instrument; but if not, he would act prudently to examine the materials of which it is composed, before he relies on its performance, and also to put to some

test the accuracy of the divisions on the vernier and limb, as well as the care that has been taken in selecting glasses of uniform thickness, and of good polish. The exactness of the total arc may be ascertained from comparison with measurements taken with a circle, or some well-known superior instrument; or by careful trigonometrical measurement on some level and extensive ground, where the sides of the triangle can be accurately measured, for which purpose Troughton's new chain of five-feet links is admirably calculated: but the intermediate divisions may be examined by the vernier itself, by stepping the arc with it; and if all parts of the arc are found alike divided, when examined by the coincidence of the extreme strokes of the vernier, the intermediate strokes of the vernier itself may lastly be examined by the strokes on the limb taken in various places. Dr. Mackay recommends a table of corrections to be made, in case of errors being detected in the dividing, but we should rather recommend new divisions from a good engine, the inserting of which can now be performed at a trifling expence. When the planes of the mirrors are examined, try if a candle reflected appears in two images; if it does, the two faces of the glass are not parallel, and consequently the glass is not fit for its purpose.

To try whether the surfaces of the mirrors be perfect planes, bring two distinct distant objects into good contact, and let them be seen at the upper edge of the silvered part; then move the instrument in its own plane, and move the image and body along the line of separation or edge of the silvered part, and if the coincidence is not disturbed the plane is perfect, but not otherwise. Also, when an observation is taken of the sun, and the vernier has been fixed by the fixing screw, read the altitude, as the dark glass, or glasses, may have been used; then remove them from the socket that holds them, and reverse their planes, by putting their remote faces nearest; and if, after this change, the same altitude is given, the planes are parallel, otherwise *half the difference* must be applied, in all such cases, as an *error of the coloured glasses*. This examination is best made exactly at noon, when the sun's altitude is not sensibly changed during the examination; unless a good chronometer or regulator, duly regulated, and put to exact time, be at hand; for then the successive examinations may take place at equal distances from noon. Or the same thing may be done by means of a luminous object placed at a distance, and so elevated, that an artificial horizon may give its *double* altitude before and after the coloured glasses are reversed in position. The best artificial horizons are either a vessel of pure mercury, with a roof of good glass framed over it to prevent agitation by the wind; or otherwise a piece of black glass, well polished, and placed on screws of adjustment, with a good spirit-level in a glass tube, so ground, that it will reverse in position, and will place the glass in a perfect level in the two requisite directions, at right angles to each other.

It may be proper to examine further if the two holes in the sight-vane are so made that the sun or other luminous body dazzles the eye more in looking through one, than in looking through the other, the intention being that one shall take in more of the silvered part, and the other more of the unsilvered part of the glass, so as to accommodate the quantity of direct light to the strength of the eye.

Illustration of the Use.—When Hadley's octant, or sextant, is used for altitudes at sea, the sun, moon, or star, as the case may be, must be viewed in the way that the eye can best bear, with or without the dark glasses, telescope, &c. as occasion may require, and as experience will dictate; and in a fore observation the body observed must have its image brought gradually down, so as to be in exact contact with the

the horizon: if the sun or moon be observed, either the upper or lower limb must be substituted for the centre, and the observation must be afterwards reduced to the centre, by applying the semi-diameter, + or —, from the proper column for the given day, as given in the Nautical Almanac, or Ephemeris; in doing this, the face of the observer must be turned towards the object whose altitude is to be measured, and while the index is gradually moved forward along the limb, the image will descend till it approaches the horizon: in this situation, care must be taken that the contact of the image be made with the visible horizon at the line of separation, between the silvered and unsilvered parts of the fore horizon-glass, that both objects may be visible together; and also that the index may not be pushed too far, so as to require a retrograde motion in finishing the contact: therefore fix the clamping piece, if there is a tangent screw, and complete the contact by a slow motion, and the altitude will remain unaltered till the vernier has been examined by a magnifying glass, which ought always to be at hand, to assist the eye in examining the coincidence of some one line of the vernier with some line of the limb; or, when there is not an exact coincidence, in estimating the quantity that is beyond coincidence, as compared with the contiguous quantity that is short of it. To succeed well in perfecting a fore observation taken at the horizon, the observer must learn to give a vibratory slow motion of his body to the right and left, his heel being the centre of motion, that the image observed may be made to move backwards and forwards in the arc of a circle, of which the horizon is a tangent, in order that the altitude may not be taken at one side of the tangential point, and consequently be too great. Care must also be taken that the faint secondary image reflected from the posterior face be not mistaken for the primary image, reflected from the proper, or anterior face of the mirror. When the altitude is marked down, as read on the limb and vernier, the corrections must be applied, for either the sun or moon, for parallax, refraction, dip of the horizon, and semi-diameter, before the true altitude of the centre is obtained: but for a star no parallax is wanted, nor yet allowance for semi-diameter; these apparently diminutive bodies being situated at such an immense distance from the earth, as to subtend no sensible angle, nor to have any perceptible parallax in altitude.

It is from meridian altitudes thus taken, that, by the application of a heavenly body's declination, + or —, as the body may be below or above the equator, the co-latitude, and consequently the latitude, is readily determined; and also, the latitude being known, from an altitude taken towards the east or west, that the time is determined at one observation, but more accurately by a series of equal altitudes taken at opposite sides of the meridian; the reduction, however, for the sun's change of declination during the interval, must, in this case, be taken from tables of correction for equal altitudes, such as are contained in the pamphlet of the late Mr. Wales.

In making the *back* observation, the coloured glass, or glasses, must be selected, as before, to suit the eye, and the plane of the instrument held vertically, as in the fore observation, but the face of the observer must view the point of the horizon *opposite* the sun, or that pointed to by his own shadow; first, let the eye be directed through the vane of the back horizon-glass to the transparent slit that divides the mirror, and let it view the horizon, then move the index till the image of the sun is just seen on the silvered part of the glass; a vibratory motion now given to the octant from the eye, as the centre of motion, will make the sun's image move in a curve of which the convex part appears uppermost; in

this situation, let the slow motion by the tangent screw, if any, bring this image till one of its limbs coincides with the horizon seen through the transparent slit, and the observed altitude will be determined as before. Whenever the horizon is clear both before and behind the observer, he may reverse his instrument and also his body hastily, when the sun is on the meridian, and make the fore and back observations check each other, which will also, from time to time, prove the respective positions of the two mirrors, and lead to a detection of the error of the back horizon-glass, when that of the former is known, which it may always be from a double measure, one back and one forwards, of the sun's diameter. If the difference of the altitudes of the same body taken both ways be equal to the known index-error of the fore horizon-glass, it will be known that the back horizon-glass has no error; but if the said quantities are not the same, their difference, + or —, will be the index-error of the back horizon-glass; hence the back horizon-glass may be adjusted from a knowledge of the error of adjustment of the fore horizon-glass, which method, we believe, was never before suggested.

QUADRANT, Hadley's, Theory of. It is a first principle in optics, that the angle of incidence, whatever be the inclination of the incident ray, is equal to the angle of reflection, *i. e.* if the angle of incidence $\angle DBA$ be 30° , the angle of reflection $\angle BDC$ will be also 30° . It is also plain, that if while the radiant A (*Plate II. Navigation, figs. 1 and 2.*) remains in the same place, the mirror EF , by revolving round B , moves into the position fe , then the alteration in the angle between the incident and reflected ray will be double to the angle shewing the change of position in the mirror. Suppose the mirror changes 10° from the radiant, then the perpendicular BD goes 10° farther from the radiant A into the position Bd ; and the incident angle $\angle DBA$ is 40° , and the reflected angle $\angle dBc$ is 40° ; so the angle $\angle ABC$ is altered from 60° to 80° ; a difference of 20° for 10° change of position in the mirror. Suppose again the mirror to change, in position, 10° towards the radiant A , then the perpendicular is changed into Bd , 10° nearer to the radiant; and the angle $\angle DBA$ of 30° becomes $\angle DBA$ of $20^\circ = \angle dBc$; so that the angle $\angle ABC$ is 40° , whereas $\angle ABC$ was 60° ; that is, by altering the position of the mirror 10° , the angle $\angle ABC$ was altered 20° . It may be otherwise demonstrated, that with a Hadley's quadrant, the angle of elevation under which an object is seen, is equal to twice the arc which the index has passed over. The instrument or angle $\angle ACB$ (*fig. 3.*) is 45° ; ab is a reflecting glass fixed parallel to CB ; CD is the index with a reflecting glass at G , so fixed as to be parallel to ab , when CD coincides with CB ; S the sun; SG a solar ray reflected from G to F , and from F to E , the place of the eye; and HFE the horizontal line at the time of the observation. Then will the angle of elevation $\angle IGS$ be equal to twice the angle $\angle BCD$; for the angle of reflection $\angle DGF =$ the angle of incidence $\angle SGC = \angle GCL$. And the angle of reflection $\angle bFE =$ the angle of incidence $\angle aFG = \angle FLE$ (ab being parallel to LE) $= \angle FEL$. But $\angle IGC = \angle HPC = \angle PCE + \angle PEC$ (the external angle being equal to the two internal and opposite) $= \angle PCE + \angle FLE = \angle PCE + \angle GCL + \angle GCL$. Or, $\angle IGC = \angle IGS + \angle SGC = \angle PCE$ (or $\angle GCL$) $\angle GCL + \angle GCL = 2\angle BCD + \angle GCL$. Consequently $\angle IGS = 2\angle BCD$. See Robert-son's Navigation, book ix. p. 295, &c. p. 390, &c.

Mr. Mitchell has recommended Hadley's quadrant for surveying, and especially the surveying of harbours, and also for piloting ships into harbours. Phil. Transf. vol. lv. art. 10. p. 70.

Mr. Wales, in captain Cook's Voyage, applied it to measuring the quantity eclipsed in an eclipse of the sun; in which operation it answers the purpose of a micrometer, to a great degree of certainty. See an account of the improvements suggested in the construction of these instruments, and also of the various uses to which they may be applied, in Magellan's Description des Octants & Sextants Anglois, &c. 4to.

Other quadrants have been contrived since, by some ingenious artists, all of which have their merit; but the particulars of their construction are too many for this place; and perhaps, on the whole, nothing preferable to Mr. Hadley's invention has yet been found.

QUADRANT, *Horodistical*, is a pretty commodious instrument; thus called from its use in telling the hour of the day.

Its construction is so simple and easy, and its application so ready, that we shall describe both, for the use of some who may want other conveniences.

QUADRANT, *Construction and Use of the Horodistical*. From the centre of the quadrant, C, (*Plate XIX. Astronomy, fig. 8.*) whose limb A B is divided into 90°, describe seven concentric circles at intervals, at pleasure; and to these add the signs of the zodiac in the order they are represented in the scheme.

2. Applying a ruler to the centre C, and the limb A B, mark upon the several parallels the degrees corresponding to the altitude of the sun when therein, for the given hours; connect the points belonging to the same hour with a curve line, to which add the number of the hour. To the radius C A fit a couple of sights, and to the centre of the quadrant C, tie a thread with a plummet; and, upon a thread, a bead to slide.

If, now, the bead be brought to the parallel in which the sun is, and the quadrant be directed to the sun till a visual ray pass through the sights, the bead will shew the hour.

For the plummet, in this situation, cuts all the parallels in the degrees corresponding to the sun's altitude. Since, then, the bead is in the parallel which the sun then describes, and through the degrees of altitude to which the sun is elevated every hour there pass hour-lines, the bead must shew the present hour. Some persons, who are not very nice, represent the hour-lines by arcs of circles, or even by straight lines; and that without any sensible error.

QUADRANT, *Sinical*, is an instrument of use in navigation. It is represented *Plate II. Navigation, fig. 4*, and consists of several concentric quadrantal arcs, divided into eight equal parts by radii, with parallel right lines crossing each other at right angles.

Now any of the arcs, *e. gr.* B C, may be accounted a quadrant, of any of the great circles of the sphere, chiefly of the horizon and meridian: if, then, B C be taken for a quadrant, *e. gr.* of the horizon, either of the sides, *e. gr.* A B, may represent the meridian; and the other, A C, will represent a parallel, or line of east and west; and all the other lines parallel to A B will also be meridians; and all those parallel to A C will be east and west parallels, or east and west lines.

Again, the eight spaces into which the arcs are divided by the radii, represent the eight points of the compass in a quarter of the horizon; each containing 11° 15'.

The arc B C is likewise divided into 90°, and each degree is subdivided into 12', diagonallywise.

To the centre is fixed a thread, as A L; which being laid over any degree of the quadrant, serves to divide the horizon.

If the sinical quadrant be taken for a fourth part of the meridian, one side thereof, A B, may be taken for the common radius of the meridian and the equator; and then the other, A C, will be half the axis of the world. The degrees of the circumference, B C, will represent degrees of latitude, and the parallels to the side A B, allumed from every point of latitude to the axis A C, will be radii of the parallels of latitude, as likewise the sine-complements of those latitudes.

Suppose, then, it be required to find the degrees of longitude contained in 83 of the lesser leagues, in the parallel of 48°. Lay the thread over 48° of latitude, on the circumference, and count thence the 83 leagues, on A B, beginning at A; these will terminate at H, allowing every small interval four leagues, and the interval between the broad lines twenty leagues. Then tracing out the parallel H G, from the point H to the thread; the part A G of the thread shews that 125 greater, or equinoctial leagues, make 6° 15', allowing twenty leagues to a degree, and three minutes for one league; and therefore that 83 lesser leagues A H, which make the difference of longitude of the course, and are equal to the radius of the parallel G I, make 6° 15' of the said parallel.

If the ship sail on an oblique course, such course, besides the north and south greater leagues, gives lesser leagues easterly and westerly; to be reduced to degrees of longitude of the equator. But these leagues being made neither on the parallel of departure, nor on that of arrival, but in all the intermediate ones, we must find a mean proportional parallel between them.

To find this, we have on the instrument a scale of cross latitudes. Suppose, then, it were required to find a mean parallel between the parallels of 40° and 60°. With your compasses take the middle between the 40th and 60th degree on the scale: this middle point will terminate against the 51st degree, which is the mean parallel required.

QUADRANT, *Use of the Sinical*. There are formed triangles upon this instrument similar to those made by a ship's way, with the meridians and parallels; the sides of which triangles are measured by the equal intervals between the concentric quadrants, and the lines N. and S.E. and W.

The lines and arcs are distinguished, every fifth, by a broader line; so that if each interval be taken for one league, there will be five between one broad line and another; and if every interval be taken for four leagues, then there will be twenty leagues, which make a sea degree, from one broad line to the other.

Now, suppose a ship to have sailed 150 leagues north-east, one fourth north; which is the third point, and makes an angle of 33° 45' with the north part of the meridian. Here are given two things; *viz.* the course, and the distance sailed; by which a triangle may be found on the instrument, similar to that made by the ship's course, and her longitude and latitude; and hence may the unknown parts of the triangle be found.

Thus, supposing the centre A to represent the place of departure; count, by means of the concentric arcs, along the point the ship sailed on, as A D, 150 leagues from A to D; then is the point D the place the ship is arrived at, which note. This done, let D E be parallel to the side A C; and then there will be formed a right-angled triangle A E D, similar to that of the ship's course, difference of longitude, and latitude: the side A E gives 125 leagues for the difference of latitude northwards; which makes 6° 15', reckoning twenty leagues to a degree, &c. and the side D E gives 83 lesser leagues answering to the parallels; which

which being reduced, as shewn above, gives the difference of longitude. And thus is the whole triangle found.

QUADRANT, in *Gunnery*, called also the *gunner's square*, is an instrument serving to elevate or point cannons, mortars, &c. according to the places they are to be levelled or directed to.

It consists of two branches, made of brass or wood; one about a foot long, eight lines broad, and one line in thickness; the other four inches long, and of the same thickness and breadth as the former. Between these branches is a quadrant divided into ninety degrees, beginning from the shorter branch, and furnished with a thread and plummet. See its figure represented in *Plate I. Gunnery*, fig. 5.

The use of this instrument is easy; nothing more being required but to place the longest branch in the mouth of the cannon or mortar, and elevate or lower it, till the thread cuts the degree necessary to hit a proposed object. See *Pointing of a Gun*.

Sometimes, also, on one of the surfaces of the long branch, is noted the division of diameters, and weights of iron bullets; as also the bores of pieces. See **CALIBER**.

QUADRANT of Altitude, is an appendage of the artificial globe, consisting of a lamina or slip of brass, the length of a quadrant of one of the great circles of the globe; and divided into ninety degrees.

At the end, where the divisions terminate, there is a nut rivetted on, and furnished with a screw, by means of which the instrument is fitted on to the meridian; and is moveable round upon the rivet, to all points of the horizon. See its figure in *Plate XIX. Astronomy*, fig. 9.

Its use is to serve as a scale in measuring of altitudes, amplitudes, azimuths, &c. See the manner of its application under the *Use of the GLOBE*.

QUADRANTAL, in *Antiquity*, a vessel in use among the Romans for the measuring of liquids.

It was at first called *amphora*; and afterward *quadrantal*, from its form, which was square every way, like a die.

Its capacity was eighty libræ, or pounds of water, which made forty-eight sextaries, two urnæ, or eight congii.

QUADRANTAL Space, in *Geometry*. See **QUADRANT**.

QUADRANTAL Triangle, is a spherical triangle, one of whose sides at least is a quadrant of a circle, and one of its angles a right angle.

QUADRANTATA TERRÆ, in our *Ancient Latin Books*, is used for a quarter of an acre, now called a *rood*; which see.

QUADRAS ISLES, in *Geography*, islands situated on the N.W. coast of North America, between Pintard's sound and the straits of Fuca; among which lies *Nootka's sound*, which see. They were so called by Capt. Ingraham, after the name of a Spanish commander of two schooners, who passed through this channel in the year 1792.

QUADRAT, **QUADRATUM**, called also *geometrical square*, and *line of shadows*, is an additional member on the face of the common Gunter's and Sutton's quadrants; of some use in taking altitudes, &c.

The quadrat more distinctly exhibited in *Plate VI. Surveying*, fig. 13. has each of its sides divided into a hundred equal parts, commencing from the extremes; so that the number 100 falls on the angle, representing tangents to the arc of the limb.

The divisions are distinguished by little lines from 5 to 5, and by numbers from 10 to 10; and the divisions being occasionally produced across, form a kind of lattice, consisting of 10,000 little squares.

The proportion here is, as radius is to the tangent of the angle of altitude at the place of observation (*i. e.* to the

parts of the quadrat cut by the thread), so is the distance between the station and the foot of the object, to its height above the eye. See **ALTITUDE**.

Use of the Quadrant, Geometrical Square, or Line of Shadows.
1. The quadrant being vertically placed, and the sights directed to the top of the tower, or other object, whose height is required; if the thread cut the side of the quadrat marked *right shadows*, the distance from the base of the tower to the point of station is less than the tower's height. If the thread falls on the diagonal of the square, the distance is just equal to the height. If it fall on that side marked *versed shadows*, the distance exceeds the height.

Hence, measuring the distance, the height is found by the rule of three; inasmuch as there are three terms given. Indeed, their disposition is not always the same; for when the thread cuts the side of right shadows, the first term in the rule of three ought to be that part of the side cut by the thread; the second, the side of the square; and the third, the distance measured. If the thread cut the other side, the first term is the whole side of the square; the second, the parts of the side cut by the thread; and the third, the distance.

For an instance of each. Suppose, *e. gr.* in looking at the top of a steeple, the thread cut the side of right shadows in the point 40, and that the distance measures 20 poles, the case then will stand thus: as 40 is to 100, so is 20 to a fourth term, which we find to be 50; the height of the steeple in poles. Again, supposing the thread to fall on the other side, in the point 60, and the distance to measure 35 poles; the terms are to be disposed thus: as 100 is to 60, so is 35 to a fourth term, *viz.* 21, the height required. See **ALTITUDE**.

Use of the Quadrant without Calculation.—The preceding cases may be formed without calculation, where the divisions of the square are produced both ways, so as to form the area into little squares.

Thus, suppose, 1. The thread to fall on 40 in the side of right shadows, and the distance be measured 20 poles; seek among the little squares for that perpendicular to the side which is 20 parts from the thread; this perpendicular will cut the side of the square next the centre, in the point 50, which is the height required in poles.

2. If the thread cuts the side of versed shadows in the point 60, and the distance be 35 poles; count 35 parts on the side of the quadrat from the centre; count also the divisions of the perpendicular from the point 35 to the thread, which will be 21, the height of the tower in poles.

Note, In all cases the height of the centre of the instrument is to be added. See **ALTITUDE**, and **SHADOW**.

QUADRAT, in *Astrology*, called also *Quartile*, an aspect of the heavenly bodies, in which they are distant from each other a quadrant, or ninety degrees. See **ASPECT**.

QUADRAT, in *Printing*, is a sort of space; that is, a piece of metal, cast like the letters, to be used occasionally in composing, in order to form the intervals between words, at the end of lines, &c. See **PRINTING**.

There are quadrats of divers sizes, as *m* quadrats, *n* quadrats, &c. which are respectively of the dimensions of such letters.

QUADRATA, in *Ancient Geography*, a town of Higher Pannonia, placed on the banks of the Save by Antonine's Itinerary.

QUADRATA, in *Geography*, a town of Naples, in the province of Bari; five miles N.W. of Ruvo.

QUADRATA is the Italian term in canto fermo for Gregorian or square black notes.

QUADRATA *Legio*, among the Romans. See *Square Legion*.

QUADRATIC EQUATION, in *Algebra*, is an equation of which the highest power of the unknown quantity rises only to the second degree. If this power enters alone, it is called a *simple quadratic*; and when the second power and simple quantity both occur, it is termed an *affected quadratic* equation, thus:

$x^2 \pm ax = b$, is an *affected quadratic*, and
 $x^2 = b$, or $ax^2 = b$, a *simple quadratic* equation.

Some authors class all such equations as contain two different powers of the unknown quantity, the one being the double of the other, under the general term quadratics, such as $x^4 \pm ax^2 = b$, $x^{2m} \pm ax^m = b$, &c. each of which is called a quadratic equation, because their solution depends upon precisely the same principles as the former.

Every quadratic may be reduced to the form $x^2 + ax = b$; in which it is, however, to be understood, that a and b may be either positive or negative; and the general solution of it is expressed by the formula

$$x = \frac{-a}{2} \pm \sqrt{\left(\frac{a^2}{4} + b\right)}$$

If we give to a and b all the variety of signs they admit of, quadratic equations may be divided into four distinct classes, viz.

1. $x^2 + ax = -b$
2. $x^2 - ax = -b$
3. $x^2 + ax = +b$
4. $x^2 - ax = +b$;

and their several roots will be exhibited by the following formulæ, viz.

1. $x = \frac{-a}{2} \pm \sqrt{\left(\frac{a^2}{4} - b\right)}$
2. $x = \frac{a}{2} \pm \sqrt{\left(\frac{a^2}{4} - b\right)}$
3. $x = \frac{-a}{2} \pm \sqrt{\left(\frac{a^2}{4} + b\right)}$
4. $x = \frac{a}{2} \pm \sqrt{\left(\frac{a^2}{4} + b\right)}$

See **EQUATIONS**.

From these forms it is obvious that every quadratic equation has two roots arising out of the ambiguous sign $\pm$, prefixed to the second member of the root. It is also obvious, that if in the 1st and 2d form, b be greater than $\frac{a^2}{4}$, the two roots in both forms are imaginary, or impossible; but if b be less than $\frac{a^2}{4}$, then they are in each form both real, being in the 1st both negative, and in the 2d both positive; because the quantity exhibited under the radical form is, in both equations, less than that without the radical; and consequently both the sum and difference will have the same sign as $\frac{a}{2}$.

In the 3d and 4th forms, the roots are necessarily both real, but one positive and the other negative; the 3d form having its greatest root negative, and 4th its greatest root positive; as is obvious by inspection.

It is, however, not necessary to consider quadratic equations under these four forms, as the solution of them all may be reduced to one general rule, as exhibited in the preceding part of this article, and which may be given in words as follows. Having reduced the proposed equation to any one

of the above forms, the roots of it will be equal to half the co-efficient of the second term, with its sign changed; plus and minus the square root of the square of that half co-efficient prefixed to b , with its proper sign, whether plus or minus. The principles on which the preceding formulæ are obtained, are these, viz. $(x \pm \frac{1}{2}a)^2 = x^2 \pm ax + \frac{1}{4}a^2$; therefore, if an equation be proposed under the form $x^2 \pm ax = \pm b$, by adding $\frac{1}{4}a^2$ to both sides, we still preserve the equality, and render the first side a complete square, that is, we have

$$x^2 \pm ax + \frac{1}{4}a^2 = \frac{1}{4}a^2 \pm b;$$

and, by extraction,

$$x \pm \frac{1}{2}a = \pm \sqrt{\left(\frac{1}{4}a^2 \pm b\right)};$$

consequently

$$x = \mp \frac{a}{2} \pm \sqrt{\left(\frac{1}{4}a^2 \pm b\right)},$$

which form includes all the preceding formulæ. We shall not here give the solution of any examples, as the reader will find sufficient exercises under the article **EQUATION**; but it may not be amiss to shew other methods of obtaining the roots of quadratic equations, viz. by sines and tangents, continued fractions, &c.

The Solution of Quadratic Equations by means of a Table of Sines, Tangents, &c.—Here, referring to our preceding four forms, the solution of them may be exhibited as follows:

Form 1. $x^2 + ax = -b$.

Put $\frac{2}{a} \sqrt{b} = \sin. z$; then

$$x = \left\{ \begin{array}{l} -\sqrt{b} \times \tan. \frac{1}{2}z \\ -\sqrt{b} \times \cot. \frac{1}{2}z \end{array} \right\} \quad \text{or,}$$

$$x = \left\{ \begin{array}{l} -\frac{1}{2}a \{1 - \cos. z\} \\ -\frac{1}{2}a \{1 + \cos. z\} \end{array} \right\}$$

Form 2. $x^2 - ax = -b$.

Put $\frac{2}{a} \sqrt{b} = \sin. z$; then

$$x = \left\{ \begin{array}{l} +\sqrt{b} \times \tan. \frac{1}{2}z \\ +\sqrt{b} \times \cot. \frac{1}{2}z \end{array} \right\} \quad \text{or,}$$

$$x = \left\{ \begin{array}{l} +\frac{1}{2}a \{1 - \cos. z\} \\ +\frac{1}{2}a \{1 + \cos. z\} \end{array} \right\}$$

Form 3. $x^2 + ax = b$.

Put $\frac{2}{a} \sqrt{b} = \tan. z$; then

$$x = \left\{ \begin{array}{l} +\sqrt{b} \times \tan. \frac{1}{2}z \\ -\sqrt{b} \times \cot. \frac{1}{2}z \end{array} \right\} \quad \text{or,}$$

$$x = \left\{ \begin{array}{l} +\frac{1}{2}a \{\sec. z - 1\} \\ -\frac{1}{2}a \{\sec. z + 1\} \end{array} \right\}$$

Form 4. $x^2 - ax = b$.

Put $\frac{2}{a} \sqrt{b} = \tan. z$; then

$$x = \left\{ \begin{array}{l} +\sqrt{b} \times \cot. \frac{1}{2}z \\ -\sqrt{b} \times \tan. \frac{1}{2}z \end{array} \right\} \quad \text{or,}$$

$$x = \left\{ \begin{array}{l} +\frac{1}{2}a \{\sec. z + 1\} \\ -\frac{1}{2}a \{\sec. z - 1\} \end{array} \right\}$$

The above formulæ result immediately from the construction of quadratic equations. Thus, in the two first forms, let AB , (*Plate XIII. fig. 6. Analysis*) represent a , and $CD = \sqrt{b}$, then AD and DB will be the required roots from the known construction of equations. See **CONSTRUCTION**.

Now here it is obvious that the $\sin. z$ represents the $\sin.$ of CED ,

QUADRATIC EQUATION.

CED, and therefore angle DCB, which is $= \frac{1}{2}$ angle CED, $= \frac{1}{2}$ angle z . Consequently $DB = CD \times \tan. \frac{1}{2} z$, and $AD = CD \times \cot. \frac{1}{2} z$, because the angle CAD = the angle BCD; which agree with the leading formulæ above given. As to the two latter formulæ for the two first cases, they are obvious without any explanation.

In the 3d and 4th cases, let AB represent a , and $DC = \sqrt{b}$, then AD and DB will represent the two roots; join BC , and draw DE parallel to BC , so shall $CE = BD$, and the angle $CDE = \frac{1}{2}$ the angle BOC . Now here the $\tan. z$ will represent the $\tan.$ of BOC , and $\frac{1}{2}z = CDE$; but $CE = BD$ is obviously equal to $DC \times \tan. CDE = \sqrt{b} \times \tan. \frac{1}{2}z$; and in the same manner $AD = \sqrt{b} \times \cot. \frac{1}{2}z$. The two latter formulæ require no illustration.

The same results might have been obtained, though not perhaps quite so obviously, from the preceding analytical solution.

There are but few cases in which it is advisable to employ the methods above described to the solution of quadratics, and therefore one example will be considered a sufficient illustration.

Exam.—Given $x^2 + \frac{7}{44}x = \frac{1695}{12716}$, to find the two roots of the equation by lines and tangents.

Here $\tan. z = \frac{88}{7} \sqrt{\frac{1695}{12716}}$

$$\begin{array}{r} \log. 1695 \quad 3.2291697 \\ \log. 12716 \quad 4.1043505 \\ \hline 2) - 1.1248192 \end{array}$$

$\log. \sqrt{\frac{1695}{12716}}$	-1.5624096
$\log. 88$	1.9444827
$\text{co. log. } 7$	9.1549020
$\log. \tan. z$	10.6617943

whence $z = 77^\circ 42' 32''$, and $\frac{1}{2} z = 38^\circ 51' 16''$

$\log. \tan. \frac{1}{2} z$	9.9061115
$\log. \sqrt{\frac{1695}{12716}}$	-1.5624096

	9.4685211
deduct radius	10.0000000
log. x	-1.4685211

or $x = .2941176$ the positive root; and if $\cot. \frac{1}{2} z$ be taken instead of $\tan. \frac{1}{2} z$, the other value of x will be found = $-.4532085$. See Bonnycastle's Algebra, vol. i. p. 141.

For the solution of quadratic equations by the method of *continued fractions*, we must refer the reader to the "Essai sur la Théorie des Nombres," by Le Gendre.

The root of a quadratic equation may be exhibited under the form of a continued furd, as follows :

Let $x^2 - ax = b$, or $x^2 = ax + b$; then

$$x = \sqrt{b + ax}$$

Or, by substituting for x , under the radical, its whole value $\sqrt{b + ax}$, we have

$$x = \sqrt{b + a \sqrt{b + ax}}$$

Substituting again for x as above, we obtain

$$x = \sqrt{b + a \sqrt{b + a \sqrt{b + a x}}}$$

and by continuing thus our successive substitutions for x , we have

$$x = \sqrt{b + a \sqrt{b + a \sqrt{b + a \sqrt{b + \&c.}}}}$$

which is an analytical expression for the positive value of x in the proposed equation.

It is obvious, however, that such an expression as this is of little or no use for solving quadratic equations; but we have by means of the latter, a very ready means of finding the ultimate value of such a continued furd. Suppose, for example, the value of the following continued furd were required, *viz.*

$$\sqrt{12} + \sqrt{12} + \sqrt{12} + \sqrt{12} + \&c.$$

Aflume

$$x = \sqrt{12} + \sqrt{12} + \sqrt{12} + \sqrt{12} + \&c.$$

By squaring both sides

$$x^2 = 12 + \sqrt{12} + \sqrt{12} + \sqrt{12} + \&c.$$

Or, since the latter part

$$\sqrt{12} + \sqrt{12} + \sqrt{12} + \&c. = x$$

this becomes

$$x^2 = 12 + x, \text{ or } x^2 - x = 12;$$

whence $x = \frac{1}{2} \pm \sqrt{12\frac{1}{4}} = 4$, which is the value of the infinite surd proposed.

Again, let there be proposed the following infinite surd,
viz.

$$\sqrt{5+4} \sqrt{5+4} \sqrt{5+4} \&c.$$

Assume the infinite sum $= x$, then by squaring

$$x^2 = 5 + 4\sqrt{5 + 4\sqrt{5 + 4\sqrt{5 + \&c.}}, \text{ or}$$

$$x^2 = 5 + 4x, \text{ or } x^2 - 4x = 5;$$

whence $x = 2 \pm \sqrt{4 + 5} = 5$, the value sought. For other examples of this kind, see SURDS.

QUADRATING of a Piece, among Gunners, is the seeing that a piece of ordnance be duly placed, and poised in its carriages; and that its wheels be of an equal height, &c.

QUADRATO, in *Music*. See QUADRO.

QUADRATO-CUBUS, QUADRATO-QUADRATO-CUBUS, and QUADRATO-CUBO-CUBUS, are names used by Diophantus, Vieta Oughtred, and others, for the fifth, seventh, and eighth powers of numbers. See POWER.

QUADRATO-QUADRATUM, or BIQUADRATUM, the fourth power of numbers; or the product of the cube multiplied by the root.

QUADRATRIX, in *Geometry*, a mechanical line, by means of which we would find right lines equal to the circumference

cumference of circles, or other curves, and of the several parts of it.

Or, more accurately, the quadratrix of a curve is a transcendental curve described on the same axis, the semi-ordinates of which being given, the quadrature of the correspondent parts in the other curve is likewise given. See CURVE.

Thus, *e. gr.* the curve AND (*Plate XIII. Analysis, fig. 7.*) may be called the quadratrix of the parabola AMC, since it is demonstrated, that $APMA = PN^2$, or $APMA = AP \times PN$, or $APMA = PN \times a$, a constant quantity, &c.

The most eminent of these quadratrices are, that of Dinostrates, and that of Mr. Tschirnhausen, for the circle; that of Mr. Perks for the hyperbola.

QUADRATRIX of *Dinostrates*, is a curve AMmm (*fig. 8.*) by which the quadrature of the circle is effected, though not geometrically, but mechanically; it is thus called from its inventor Dinostrates.

Its genesis is thus: divide the quadrantal arc ANB into any number of equal parts, in N, *n*, &c. by a continual bisection; divide the radius AC into the same number of parts in the points P, *p*, &c. Draw radii CN, C*n*, &c. Lastly, on the points P, *p*, &c. erect perpendiculars PM, *p*m, &c. The curve formed by connecting these lines is the quadratrix of Dinostrates.

This curve may be described by continual motion; if we suppose the radius CN by its extreme N to describe uniformly the arc AB, and at the same time a ruler PM, always parallel to itself, to move uniformly along AC, in such a manner that when the ruler PM arrives at C, the radius CN may coincide with CB; and thus the continual intersection of CN with the ruler PM will describe the quadratrix AMD.

Here, from the construction, $ANB : AN :: AC : AP$; and therefore, if $ANB = a$, $AC = b$, $AN = x$, $AP = y$; $ay = bx$. See QUADRATURE.

QUADRATRIX *Tschirnhausiana*, is a transcendental curve AMmmB (*fig. 9.*) by which the quadrature of the circle is likewise effected; invented by Mr. Tschirnhausen, in imitation of that of Dinostrates.

Its genesis is thus conceived; divide the quadrant ANB, and its radius AC, into equal parts, as in the former; and from the points P, *p*, &c. draw the right lines PM, *p*m, &c. parallel to CB; and from the points N, *n*, &c. the right lines NM, *n*m, &c. parallel to AC. The points A, M*m*, being connected, the quadratrix is formed; in which $ANB : AN :: AC : AP$. And therefore, if $AB = a$, and $AC = b$, $AN = x$, and $AP = y$; $ay = bx$. See QUADRATURE.

This curve may be also described by continued motion, if two rulers, NM and PM, perpendicular to each other, be made to move uniformly and parallel to themselves, the one along the quadrant of the circle AC, and the other along the radius.

QUADRATUM-CUBI, QUADRATO-QUADRATO-QUADRATUM, and QUADRATUM *Surdosolidi*, &c. are names used by the Arabs for the sixth, eighth, and tenth powers of numbers. See POWER.

QUADRATUM *Os*, in *Comparative Anatomy*, *os carrè* of the French; a small bone in the head of birds, to which the lower mandible is articulated. See BIRDS, in *Comparative Anatomy*, in the division relating to the bones.

QUADRATURE, in *Geometry*, signifies literally the finding of a square equal in area to any given figure, which was the method the ancients made use of when they had in view the determination of the surface of any space; but

the term *quadrature* has now a more indefinite signification; implying, in general, the determination of the area of a figure, without any reference to the geometrical exhibition of it, in a square or other rectilinear form.

All rectilinear figures being immediately reduced to, or dependent upon, the area of triangles, their quadratures have been known from the highest antiquity; but the quadratures of curvilinear spaces are, with very few exceptions, of modern date, two only having been known till near the beginning of the eighteenth century.

The first curvilinear space whose quadrature was accurately determined, was the lune of Hippocrates, of which an account will be found under the article LUNE. Archimedes next found the area of the common parabola; which he obtained in a very ingenious manner, by inscribing an isosceles triangle in the parabola, then two isosceles triangles on the equal sides of the former, four others on these, and so on, which he found to have a certain relation, decreasing in the proportion $1, \frac{1}{4}, \frac{1}{16}$, &c. the infinite sum of which series would therefore express the area of the parabola, or the area of all the triangles of which he thus conceived it to be composed; and which sum he found to be $1\frac{1}{3}$ or $\frac{4}{3}$ of the circumscribing rectangle. After this time, a period of near two thousand years elapsed, without producing the quadrature of a single curvilinear figure, although the subject seems to have engaged the attention of the most eminent mathematicians during that long interval, particularly the quadrature of the circle. This figure, being the most simple in appearance and construction of any contained under a curve line, was well calculated to excite the curiosity of mathematicians. Archimedes doubtless attempted the solution of this problem; but failing in producing the exact quadrature, he contented himself with giving an approximation, shewing by the inscription and circumscription of a polygon of ninety-six sides, that the diameter being 1, the circumference was greater than $3\frac{1}{7}$, but less than $3\frac{1}{2}$; and as it was known, even before the time of Archimedes, that the area of a circle is equal to that of a right-angled triangle, whose altitude is equal to the radius, and base equal to the circumference of the circle, it follows, that the area would be greater than $\frac{22}{7}$, but less than $\frac{25}{8}$.

It would be useless to attempt in this place to enumerate the various absurd quadratures which have been, from time to time, published by minor geometers, with all that conceit and confidence which seldom fail to accompany inferiority. Some attributed their success to divine inspiration; others to their own superior talents: some offered large sums of money to those who should discover any error in their investigation, while others expected great rewards from their government, as a recompence for their discovery, foolishly attaching great importance to a problem, which, if it could be accurately solved, would serve no other purpose but to gratify the curiosity of mathematicians. Many of these attempts, however, have been rendered somewhat amusing by an excess of absurdity. This is particularly the case with regard to the work of Jaime Falcon, a Spaniard of the order of Notre Dame, of Montefal, published at Anvers in 1587. This treatise opens with a dialogue in verse between himself and the circle, which thanks him very affectionately for having squared him; but the good and modest knight attributes all the honour of the discovery to the holy patron of his order. See Montucla's "Histoire des Recherches sur la Quadrature du Cercle;" or his "Histoire des Mathematiques," vol. iv. p. 619.

Referring those readers who have the curiosity to examine the reveries above-mentioned to the two preceding works, we propose to give here an abstract from the same, of what has

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has been done on this subject, by way of approximation. We have already observed that Archimedes was the first who gave an approximation of the ratio of the diameter to the circumference of a circle, placing it between the limits 1 to $3\frac{1}{4}$, and 1 to $3\frac{1}{2}$; and it is said that Apollonius and Philo found more accurate approximations, which, however, have not been transmitted to us.

Towards the year 1585, Metius, combatting the false quadrature of Simon Duchêne, gave the ratio of 113 to 355, which is very exact, being only $\frac{1}{1000000}$ in excess. Vieta found a still nearer approximation, carrying it to ten decimals, whereas the former is true only to six places. He also gave a kind of series, the infinite sum of which was equal to the entire circle.

Adrianus Romanus carried the approximation to seventeen figures, and Ludolph van Ceulen to thirty-six; which he published in his work "De Circulo et Adscriptis;" and of which Snellius published a Latin translation in 1619. He afterwards verified Van Ceulen's approximation by some theorems of his own invention, which greatly facilitated the computation, and which he published in 1621, under the title of "Willebrordi Snellii Cyclometricus de Circuli Dimensione, &c."

Descartes found a geometrical construction from which it was easy to draw an expression in the form of a series; and Huygens afterwards discovered some curious theorems connected with this subject, but did not advance the approximation, though he made some useful rules for approximating towards the length of the circular arc.

One of the most curious discoveries connected with this subject, which had yet been published, was that given by Wallis in his "Arithmetica Infinitorum," in 1655; where he shews that the ratio of a circle to the square of its diameter, is truly expressed by the infinite fraction

$$\frac{3^2 \cdot 5^2 \cdot 7^2 \cdot 9^2 \cdot 11^2 \cdot \&c.}{2 \cdot 4^2 \cdot 6^2 \cdot 8^2 \cdot 10^2 \cdot 12^2 \cdot \&c.}$$

If we limit ourselves, as we must do to, a finite number of terms, we shall have a ratio alternately too great and too small, according as we take an even or an odd number of terms:

thus, $\frac{3}{2}$ is too great; $\frac{3 \cdot 3}{2 \cdot 4}$ too small; $\frac{3 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6}$ too great; and

$\frac{3 \cdot 3 \cdot 5 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 8}$ too small, and so on; but each of these is a nearer

approximation than the preceding ones. But in order to approach still nearer in both cases, the author proposed to multiply the whole product by the square root of a binomial, viz. unity, plus unity divided by the last figure, with which the series terminated either in the numerator or denominator; in which case, the product will be a much nearer approximation; it will be too great if we use the last figure of the numerator, and too small if the last of the denominator. Thus we shall have for the ratio sought, alternately in excess and defect.

In excess.

$$\frac{3 \cdot 3 \cdot 5 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 8} \sqrt{1 \times \frac{1}{2}}$$

$$\frac{3 \cdot 3 \cdot 5 \cdot 5 \cdot 7 \cdot 7}{2 \cdot 4 \cdot 6 \cdot 8 \cdot 10 \cdot 12} \sqrt{1 \times \frac{1}{3}}$$

&c.

In defect.

$$\frac{3 \cdot 3 \cdot 5 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 8} \sqrt{1 \times \frac{1}{2}}$$

$$\frac{3 \cdot 3 \cdot 5 \cdot 5 \cdot 7 \cdot 7}{2 \cdot 4 \cdot 6 \cdot 8 \cdot 10 \cdot 12} \sqrt{1 \times \frac{1}{3}}$$

&c.

Prior to the above series of Dr. Wallis, however, some thing of an equivalent expression, though given under a different form, was discovered by lord Brounker, which is as fol-

lows. The circle itself being 1, the square of its diameter is expressed by the infinite continued fraction.

$$1 + \frac{1}{2 + \frac{1}{3^2 + \frac{1}{2 + \frac{1}{5^2 + \frac{1}{2 + \frac{1}{7^2 + \frac{1}{2 + \frac{1}{9^2 + \frac{1}{2 + \&c.}}}}}}}}}$$

of which the law of the denominators is obvious. See CIRCLE.

Such was the progress which mathematicians had made towards the solution of this interesting problem prior to the invention of fluxions, which, by reducing the quadrature of all curves to one general principle, again revived the hopes of success with regard to the circle, notwithstanding some pretended demonstrations of its impossibility; and its quadrature was accordingly again attempted with the greatest eagerness. The quadrature of a space, and the rectification of a curve, were now reduced to that of finding the fluent of a given fluxion but still the problem was found to be incapable of a general solution in infinite terms. The fluxion of a given fluent was found to be always assignable, but the converse proposition, viz. of finding the fluent of a given fluxion, could only be effected in particular cases; and amongst the exceptions, to the great regret and disappointment of geometricians, was included the case of the circle with regard to every form of fluxion under which it could be obtained. Some exceedingly near approximations have, however, since been made towards the true ratio of the diameter to the circumference of the circle, but these belonging rather to the article RECTIFICATION than to QUADRATURE, we shall enter again upon the subject under the former term, and shall occupy the remainder of the present article on the quadrature of curves in general.

On the Quadrature of Curves by Fluxions. In order to exhibit more distinctly and at large the use of fluxions, according to the modern method of notation, in finding the areas of curves, we shall premise the two following cases.

Case 1.—Let A R C (Plate XIII. *Analysis*, fig. 10.) be a curve of any kind, whose ordinates R b, C B, are perpendicular to an axis A B. Imagine a right line b R g, perpendicular to A B, to move parallel to itself from A towards B; and let its velocity, or the fluxion of the abscissa A b, in any proposed situation of that line, be denoted by $\dot{b} d$; then will the rectangle b n express the fluxion of the generated area A b R, which (if A b = x, and b R = y) will be = $y \dot{x}$: whence, by substituting for y or $\dot{x}$ (according to the equation of the curve,) and taking the fluent, the area itself will become known.

Case 2.—Let A R M (fig. 11.) be any curve whose ordinates C R, C R, are all referred to a point or centre; and conceive a right line C R H to revolve about the given centre C, and a point R to move along the said line, so as to describe the curve live A R M. If this point were to move from Q, without changing its direction or velocity, it would proceed along the tangent Q S (instead of the curve), and describe areas Q S C, Q S C, about the centre C, proportional to the times in which they were described; because, having the same altitude C P, they are as the bases Q S and Q S. Consequently, if R S be taken to denote the value of $\dot{z}$ the fluxion of the curve line A R, the corresponding fluxion

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fluxion of the area A R C will be justly represented by the uniformly generated triangle Q C S; which, expressing C P by s , will be $= \frac{Q S \times C P}{2} = \frac{s \dot{z}}{2}$: whence the area itself may

be determined. But since, in many cases, the value of $\dot{z}$ cannot be computed (from the property of the curve) without trouble, the two following expressions, for the fluxion of the

area, will be found more commodious, viz. $\frac{s y \dot{y}}{2 t}$ and $\frac{y^2 \dot{x}}{2 a}$;

where $t = R P$, and $x =$ the arc B N of a circle, described about the centre C, at any distance $a = C B$. These expressions are derived from that above in the following manner;

viz. $\dot{z} : \dot{y} :: y (C R) : t (R P)$; therefore $\dot{z} = \frac{y \dot{y}}{t}$; consequently

$\frac{s \dot{z}}{2} = \frac{s y \dot{y}}{2 t}$. Moreover, because the celerity of R in the direction of the tangent is denoted by $\dot{z}$, that in a direction perpendicular to C Q (whereby the point R revolves

about the centre C) will, therefore, be $= \frac{C P}{C R} \times \dot{z} = \frac{s \dot{z}}{y}$;

which, being to $\dot{x}$ the celerity of the point N about the same centre as the distance or radius C R (y) to the radius C N (a), we shall, by multiplying extremes and means, have

$\frac{a s \dot{z}}{y} = y \dot{x}$, and, consequently, $\frac{s \dot{z}}{2} = \frac{y^2 \dot{x}}{2 a}$. In the examples subjoined, the letters x , y , z , and u will be used to denote the abscisse, ordinate, curve-line, and area respectively.

QUADRATURE of a Right-angled Triangle. Let the base A H (fig. 12.) = a , the perpendicular H M = b , and let A B (x) be any portion of the base, considered as a flowing quantity, and B R (y) be the corresponding ordinate. Then, the triangles A H M and A B R being similar, we shall

have $a : b :: x : y$. Whence $y \dot{x}$ (the fluxion of the area A B R) = $\frac{b x \dot{x}}{a}$; and its fluent (see *Inverse Method*

of FLUXIONS) or the area itself = $\frac{b x^2}{2 a}$, which, when $x = a$,

and B R coincides with H M, will become $\frac{a b}{2} = \frac{A H \times H M}{2}$

= the area of the whole triangle A H M. See *Mensuration of TRIANGLES*.

QUADRATURE of a Circular Sector. Let A O R (fig. 13.) be the sector; A O or O R, its radius, = a , the arc A R, considered as variable by the motion of R, = z , and R r

= $\dot{z}$; the fluxion of the area will be $\frac{a \dot{z}}{2}$ = the triangle

O R r: whence the area itself is = $\frac{a z}{2} = A O \times \frac{1}{2} A R$:

that is, the area of any circle is expressed by a rectangle under half the circumference and half the diameter. See CIRCLE.

QUADRATURE of a Semicircle. Let the semicircle be A R E H (fig. 14.); its diameter A H = a , A B = x , and B R = y , &c. and we have $y^2 (B R^2) = a x - x^2$ (A B $\times$ B H), and, consequently, $u (y \dot{x}) = \dot{x} \sqrt{(a x$

$- x^2)} = a^{\frac{1}{2}} x^{\frac{1}{2}} \dot{x} \times \left(1 - \frac{x}{a}\right)^{\frac{1}{2}}$; which expression being

resolved into an infinite series, we shall have $\dot{u} = a^{\frac{1}{2}} x^{\frac{1}{2}} \dot{x} \times \left(1 - \frac{x}{2 a} - \frac{x^2}{8 a^2} - \frac{x^3}{16 a^3} - \frac{5 x^4}{128 a^4}, \&c.\right) =$

$a^{\frac{1}{2}} \times \left(x^{\frac{1}{2}} \dot{x} - \frac{x^{\frac{3}{2}} \dot{x}}{2 a} - \frac{x^{\frac{5}{2}} \dot{x}}{8 a^2} - \frac{x^{\frac{7}{2}} \dot{x}}{16 a^3}\right), \&c.$ Whence, the

fluent of every term being taken, there will arise $u = a^{\frac{1}{2}}$

$\times \left(\frac{2 x^{\frac{3}{2}}}{3} - \frac{x^{\frac{5}{2}}}{5 a} - \frac{x^{\frac{7}{2}}}{28 a^2} - \frac{x^{\frac{9}{2}}}{72 a^3} - \frac{5 x^{\frac{11}{2}}}{704 a^4}, \&c.\right) = x$

$\sqrt{a x} \times \left(\frac{2}{3} - \frac{x}{5 a} - \frac{x^2}{28 a^2} - \frac{x^3}{72 a^3} - \frac{5 x^4}{704 a^4}, \&c.\right)$

= the area A B R. When $x = \frac{1}{2} a$, the ordinate B R will coincide with the radius O E, in which case the area becomes = $\frac{1}{2} a \sqrt{\frac{1}{2} a a} \times \left(\frac{2}{3} - \frac{1}{10} - \frac{1}{112} - \frac{1}{3584} - \right.$

$\left. \frac{5}{11767}, \&c.\right) = \frac{a^2 \sqrt{\frac{1}{2}}}{2} \times (0.6666 - 0.1 - 0.0089$

$- 0.0017 - 0.0004, \&c.) = 0.1954 a^2$; which, multiplied by 2, gives $0.3928 a^2$ for the area of the semicircle, nearly. In order to obtain a more converging series,

let the arc A R be $= \frac{1}{2} A E = 30^\circ$, and the sine B R (being half the chord of double the arc or half the side of a hexagon, i. e. half the radius), will be $= \frac{1}{2} A O$;

and A B (x) = A O - O B = A O - $\sqrt{(O R^2 - B R^2)}$; which, radius being 1, will be = 0.1339746 nearly: substitute this quantity, with the value of a in the above series,

$\sqrt{a x} \times \left(\frac{2}{3} - \frac{x}{5 a} - \frac{x^2}{28 a^2} - \&c.\right)$ and we shall have

$0.0693505 \times (0.6666666 - 0.0133975 - 0.0001603 -$

$0.0000042 - \&c.) = 0.0693505 \times 0.6531046 = 0.0452931$

= the area A B R: which, added to the area O B R (= O B $\times \frac{1}{2}$ B R = $\sqrt{\frac{3}{4}} \times \frac{1}{4} = 0.2165063$) gives

0.2617994 for the area of the sector A O R; the treble of which, or 0.7853982 (A R being $= \frac{1}{2} A E$), will be the content of the whole quadrant A O E; which number,

found by taking only four terms of the series, is true to the last decimal place.

We might have found a series of more rapid convergency, but shall reserve that part of our investigation for the article RECTIFICATION.

QUADRATURE of the Lunes. See LUNES.

QUADRATURE of the Ellipse. The ellipse, also, is a curve whose precise quadrature in definite terms is not yet effected. Indeed the area of an ellipse, being an exact mean proportional between the areas of the circles described upon its two axes, is obviously dependent upon the latter; and it is, therefore, useless to repeat the operation.

QUADRATURE of the Parabola. Let the curve A R M H (fig. 15.), be the common parabola, in which $y^2 (B R^2) = a x$ (A B $\times$ a, the parameter). See CONIC SECTIONS.

Whence we have $y = a^{\frac{1}{2}} x^{\frac{1}{2}}$, and $\dot{u} (y \dot{x}) = a^{\frac{1}{2}} x^{\frac{1}{2}} \dot{x}$; and, therefore, $u = \frac{2}{3} \times a^{\frac{1}{2}} x^{\frac{3}{2}} = \frac{2}{3} a^{\frac{1}{2}} x^{\frac{1}{2}} \times x = \frac{2}{3} y x = \frac{2}{3} \times A B \times B R$. Hence a parabola is $\frac{2}{3}$ of a rectangle of the same base and altitude.

The value of the area may also easily be found in terms of y . Thus x being = $\frac{y^2}{a}$, we have $\dot{x} = \frac{2 y \dot{y}}{a}$, and $\dot{u}$

$(y \dot{x}) = \frac{2 y^2 \dot{y}}{a}$: whence $u = \frac{2 y^3}{3 a} = \frac{2 y}{3} \times \frac{y^2}{a} = \frac{2 y}{3} \times$

$x = \frac{2}{3} \times A B \times B R$. See PARABOLA.

In the cubic parabola, whose equation is $p^2 x = y^3$; we have

have $y = p^{\frac{2}{3}} x^{\frac{1}{3}}$; multiply this by $\dot{x}$, and we have $y \dot{x} = p^{\frac{2}{3}} x^{\frac{1}{3}} \dot{x}$, for the fluxion of the area. Therefore fluent $y \dot{x} = \frac{3}{4} p^{\frac{2}{3}} x^{\frac{4}{3}} = \frac{3}{4}$ of $x y$, that is, area $= \frac{3}{4}$ of circumscribing rectangle.

And in the same manner, it will be found that in the general parabola, whose equation is $a^{n-1} x = y^n$; the area $= \frac{n}{n+1} \times$ circumscribing rectangle.

QUADRATURE of the Hyperbola. The analytical quadrature of this curve was first given by N. Mercator of Holstein, the first inventor of infinite series. But Mercator finding his series by division, Sir Isaac Newton and M. Leibnitz improved upon his method; the one seeking them by the extraction of roots, the other by a series presupposed. See HYPERBOLA.

QUADRATURE of the Asymptotic Spaces in an Hyperbola. Let DEF (fig. 16.) be an hyperbola, of which the asymptotes are CM and CN; to find the area EGHF, comprehended between the ordinates GE and FH.

Let CG = a , GE = b , GH = x , FH = y ; then by the property of the hyperbola, CG $\times$ GE = CH $\times$ HF,

or $ab = (a - x)y$, or $y = \frac{ab}{a - x}$; and, therefore, $y \dot{x} =$

$\frac{ab \dot{x}}{a - x}$; the fluent of which is $ab \times \text{hyp. log. } (a - x)$,

which fluent, however, requires a correction, for when $x = 0$, the area = 0; but the above expression when $x = 0$ is $ab \times \text{hyp. log. of } a$, therefore the correction is $- ab \times \text{hyp. log. of } a$, that is, the correct fluent which expresses the area is $ab \times \text{hyp. log. } (a - x) - ab \times \text{hyp. log. } a$, or area EGFH = $ab \times \text{hyp. log. } \frac{a - x}{a}$.

If CG and GE each = 1; $y \dot{x} = \frac{\dot{x}}{1 - x}$, the fluent of which is hyp. log. $(1 - x)$, which requires no correction.

QUADRATURE of the Cycloid. Let CAL (fig. 17.) be a cycloid, AD the axis, ABD the generating circle, AF a tangent at the vertex, CF parallel to AD.

Take any point P in the arc, and draw PM perpendicular to AM. Then the fluxion of the external area AMP = PM $\times$ the fluxion of AM.

Let AE = x , AD = $2a$; then BE = $\sqrt{(2ax - x^2)}$

and the fluxion of BE = $\frac{(a - x) \dot{x}}{\sqrt{(2ax - x^2)}}$.

Also PB = the arc BA; therefore the fluxion of PB = $\frac{a \dot{x}}{\sqrt{(2ax - x^2)}}$; and the fluxion of PB + BE, or of

AM = $\frac{(2a - x) \dot{x}}{\sqrt{(2ax - x^2)}}$; therefore the fluxion of the area

APM, or PM, $\times$ by the fluxion AM = $\frac{(2ax - x^2) \dot{x}}{\sqrt{(2ax - x^2)}}$ = $\dot{x} \sqrt{(2ax - x^2)}$.

But the fluent of this fluxion is the same as that found above for a circle, whose radius is a , and versed sine x ; that is, the area ABE; and, therefore, when $x = 2a$, the whole external area CFA is equal to the area of the semicircle ABD. But CD being equal to the semicircumference AD, the whole rectangle CDAF = four times the semicircle ABD, and consequently the internal area ACD = three times the semicircle ABD; or the whole area of

the cycloid equal three times the area of its generating circle.

QUADRATURE of the Logistic, or Logarithmic Curve. Let the subtangent PT (fig. 18.) = a , PM = x , Pp = dx ; then will

$$\frac{y \dot{x}}{y} = a$$

$$y \dot{x} = ay$$

and fluent of $y \dot{x} = ay$.

Wherefore the indeterminate space HPMI, is equal to the rectangle of PM into PT.

Hence, 1. Let QS = z ; then will the indeterminate space ISQH = az ; and, consequently, SMPQ = $ay - az = a(y - z)$; that is, the space intercepted between the two logistic semiordinates is equal to the rectangle of the subtangent into the difference of the semiordinates.

2. Therefore the space BAPM is to the space PMSQ as the difference of the semiordinates AB and PM is to the difference of the semiordinates PM and SQ. See LOGARITHMIC CURVE.

QUADRATURE of the Logarithmic Spiral. Let CBAC (fig. 19.) be the area proposed: let the right line AT touch the curve at A, upon which, from the centre C, let fall the perpendicular CT: then, since by the nature of the curve, the angle TAC is every where the same, the ratio of AT (t) to CT (x) will be constant: and,

therefore, the fluent of $\frac{t}{t} \times \frac{y \dot{y}}{2} = \frac{t}{t} \times \frac{y^2}{4}$ = the required area.

QUADRATURE of the Spiral of Archimedes. Let CRR (fig. 20.) be the curve, whose area CRgC is required. Let AC be a tangent at the centre C, about which centre, with any radius AC (= a), suppose a circle Agg to be described: then the arc or absciss Agg corresponding to any proposed ordinate CR, being to that ordinate in a constant ratio

(e. gr. as m to n) we have x (Ag) = $\frac{my}{n}$; therefore $\dot{u} =$

$\frac{y^2 \dot{x}}{2a} = \frac{my^2 \dot{y}}{2an}$; consequently $u = \frac{my^3}{6an}$ = the area

CRRgC. See SPIRAL of Archimedes.

QUADRATURE of Descartes' Curve, which is defined by the expression, $b^2 : x^2 :: b - x : y$.

Since $b^2 y = bx^2 - x^3$

$$y = (bx^2 - x^3) \div b^2$$

$$y \dot{x} = (bx^2 \dot{x} - x^3 \dot{x}) \div b^2$$

$$\text{flu. } y \dot{x} = x^3 \div 3b - x^4 \div 4b^2.$$

QUADRATURE of all Curves comprehended under the general Equation, $y = \sqrt[n]{(x + a)}$.

Since $y = (x + a)^{\frac{1}{n}}$

$$y \dot{x} = \dot{x} (x + a)^{\frac{1}{n}}$$

Make $(x + a)^{\frac{1}{n}} = v$

Then $x + a = v^n$, or $x = v^n - a$

Whence $\dot{x} = m v^{m-1} \dot{v}$

$y \dot{x} = m v^m \dot{v}$, the fluent of which is

$$\frac{mv^{m+1}}{m+1} = \frac{m}{m+1} (x+a) (x+a)^{\frac{1}{n}} = \frac{m}{m+1} (x+a)^{\frac{m+1}{n}}.$$

Let $x = 0$; the remainder will be $\frac{m}{m+1} a^{\frac{m+1}{n}}$.

Whence, the area of the curve $= \frac{m}{m+1} (x+a)^{\frac{m}{m+1}} \sqrt{x+a}$
 $= \frac{m a}{m+1} \sqrt{x+a}.$

See on the subject of this article Maclaurin's Fluxions, and Simpson's Fluxions, vol. i. sect. 7. p. 121, &c.

QUADRATURE, in *Astronomy*, that aspect, or situation of the moon, when she is 90 degrees distant from the sun.

Or, the quadrature is when she is in a middle point of her orbit, between the points of conjunction and opposition; which happens twice in each revolution, viz. in the first and third quarter.

When the moon is in her quadrature, she exhibits that phasis which we call the half-moon, i. e. she shines with just half her face; and is said to be bisected, or dichotomized.

In the moon's progress from the syzygies to her quadrature, her gravity towards the earth is continually increasing by the action of the sun; and her motion is retarded for the same reason. Her motion then, in her orbit, is slowest as her gravity to the earth is greatest when in the quadratures.

In her recess from the quadratures to the syzygies, the gravity continually decreases, and the velocity increases. The ratio is thus: as radius is to the sun, or difference of one and a half the cosine of double the distance of the moon from the syzygy, and half the radius; so is the addition of gravity in the quadratures to the diminution or increase of it in any other situation. See SYZYGy.

Hence the moon's orbit is more convex in the quadratures, than in the syzygies; and hence the circular figure of the moon's orbit is changed into an oval, whose greater axis goes through the quadratures; and hence, also, the moon is less distant from the earth at the syzygies, and more at the quadratures.

It is no wonder, therefore, that the moon should approach nearer the earth when her gravity is diminished; that access not being the immediate effect of this diminution, but of the inflexion of the orbit towards the quadratures.

In the quadratures, and within thirty-five degrees of them, the apses of the moon go backwards, or move in *antecedentia*; but they move forwards in the syzygies. See APSES.

The moon's orbit undergoes various alterations in each revolution. Its excentricity is the greatest when the line of the apses is in the syzygies; and the least, when in the quadratures.

Considering one entire revolution, the nodes move slower and slower as the moon approaches the quadratures, and they rest when she is in them; but considering several revolutions, the nodes go back faster in the quadratures.

The inclination of the plane of the moon's orbit increases as the nodes go from the syzygies, and is greatest when the nodes are in the quadratures. See MOON and NODES.

QUADRATURE Lines, or Lines of Quadrature, are two lines frequently placed on Gunter's sector.

They are marked with the letter Q, and the figures 5, 6, 7, 8, 9, 10; of which Q signifies the side of a square, and the other figures the sides of polygons of 5, 6, 7, &c. sides. S there stands for the semi-diameter of a circle; and 90 for a line equal to ninety degrees in circumference.

QUADRATUS, in *Biography*, an early Christian writer, who flourished under the reigns of Trajan and Adrian. He is styled by Jerome and Eusebius "a disciple of the apostles;" and he was reported to have been endowed with the gift of prophecy. According to Eusebius, Quadratus

presented to the emperor Adrian, in the year 126, an apology for the Christian religion, with a view of mitigating the sufferings inflicted upon the professors of that period. This is supposed to have been the first written apology presented on the same subject to any of the Roman emperors, and it produced a considerable effect on the mind of Adrian. Of this work only a fragment remains, which is preserved by Eusebius, and which is extremely valuable on account of the testimony which it affords to the reality of the miracles of Christ and his apostles, by asserting that some of those miracles were wrought on persons who were living at the time when Quadratus wrote. Nothing is known respecting the time and manner of his death. Lardner.

QUADRATUS, in *Anatomy*, a name given to several muscles of the body, on account of their form.

QUADRATUS Femoris, *le carré, ischio-trochanterien*; is situated at the upper and back part of the thigh, and extends from the tuberosity of the ischium to the great trochanter. It is flattened, quadrilateral, and tolerably thick. The posterior surface is covered by the gluteus maximus, the sciatic nerve, and the semi-membranofus; the anterior surface covers the obturator externus, the extremity of the tendon of the psoas magnus, and the back of the trochanter minor. The superior edge is parallel to the inferior geminus; and the inferior to the upper fibres of the adductor magnus. The inner edge, or origin of the muscle, is fixed to the outer side of the tuberosity of the ischium, in front of the semi-membranofus; the outer is attached to the bony ridge, which runs from the great to the small trochanter. It is tendinous at its two attachments, and fleshy in other parts. It will rotate the thigh upwards upon the pelvis; or, if the former be fixed, it will move the pelvis upon the thigh. When the thigh has been carried upwards and outwards, it will restore the limb to its natural position.

QUADRATUS Genæ, a muscle of the lower lip; see the article DEGLUTITION, where it is described under the name of *depressor labii inferioris*.

QUADRATUS Lumborum. See LUMBORUM.

QUADRATUS Occipitis, a name of the posterior or occipital portion of the *Epicranius*; which see.

QUADRELLA, in *Geography*, a town of Naples, in Lavora; 20 miles E.N.E. of Naples.

QUADRELS, in *Building*, a kind of artificial stones, perfectly square; whence their name. They are made of a chalky, or whitish and pliable earth, &c. dried in the shade for at least two years.

They were formerly in great request among the Italian architects.

QUADRICEPS, in *Anatomy*, a name under which it has been proposed to describe the extensors of the knee-joint, viz. the vastus internus and externus, the *cruræus*, and *rectus*; and the adductors of the thigh, with the *pectinalis*.

QUADRIGA, formed from *quatuor*, four, and *jugum*, yoke, in *Antiquity*, a car, or chariot, drawn by four horses, harnessed abreast.

Various are the accounts we have of the inventor of the quadriga. Cicero makes it the invention of Minerva. Hyginus attributes it to Erichthonius IV. king of the Athenians; which sentiment Virgil also follows in his *Georgics*, lib. iii. ver. 113. Æschylus gives Prometheus the honour of it. Tertullian, *De Spectac.* lib. ix. says, it was invented among the Argians, by Trochilus, in honour of Juno; and at Rome, by Romulus, in honour of Mars, or Quirinus. Ado of Vienne, *Chronic.* act. iii. will have it to have been invented by one Procidus, about the time of the establishment of the kingdom of Athens. Laziardels,

Hist.

Hist. Univerf. Epitom. lib. xxiv. fays the fame of Triptolemus. Laftly, if there be not opinions enough already, Herodotus gives us another; and fays, the Greeks borrowed it from the Libyans. Pliny tells us, that his feal was a quadriga, lib. xvi.

On the reverfes of medals we frequently fee Victory, or the emperor, in a quadriga, holding the reins of the horfes; whence thefe coins are called, among the curious, *nummi quadrigati*, and *victriatii*. See *BIGATI*.

QUADRIGA, from *quatuor* and *juga*, yokes, in *Surgery*, a bandage for the fternum and ribs, fo called from its refemblance to the trappings of a four-horfe car. It was formerly employed in cafes of fractured ribs; but, as it is not now in ufe, a more particular account of it feems unneceffary.

QUADRIGEMINA CORPORA, in *Anatomy*, a part of the brain, known more commonly by the terms nates and teftes. See *BRAIN*.

QUADRILATERAL, in *Geometry*, a figure whose perimeter confifts of four right lines, making four angles; whence it is alfo called a quadrangular figure.

If the feveral angles be right, the figure is a rectangular quadrilateral. If oblique, an oblique-angular quadrilateral.

If the fides of a quadrilateral be equal, and the angles right, the figure is a fquare.

If the fides be equal, but the angles unequal, the figure is a rhombus.

If the angles be equal, and the fides unequal, the figure is a rectangle.

If only the oppofite angles and fides be equal, the quadrilateral is a rhomboides.

If the oppofite angles and fides be unequal, the quadrilateral is a trapezium.

If any fide of a quadrilateral, infcribed in a circle, be produced out of the circle, the external angle will be equal to the oppofite, internal angle.

Hence, the two oppofite angles of any quadrilateral figure infcribed in a circle, always make two right angles; and, therefore, no oblique-angled parallelogram can have a circle defcribed about it, becaufe its oppofite angles being equal, muft together be greater or lefs than two right angles. See *CIRCLE*.

QUADRILL, *QUADRILLA*, a little troop or company of cavaliers, pompoufly drefsed and mounted; for the performance of caroufals, juits, tournaments, runnings at the ring, and other gallant divertifements.

The word is borrowed from the Italian, being a diminutive of *squadra*, a company of fouldiers ranged in a fquare: for *squadrare* is, properly, to difpofe any thing fquare; whence their *quadriglia*, the French *squadille* and *quadrille*, and our *quadrill*. The French formerly wrote *squadille*, and *efquadille*.

A regular caroufal is to have at leaft four, and at moft twelve, quadrills.

Of thefe quadrills, each is to confift of at leaft three cavaliers, and at moft of twelve.

The quadrills are diftinguifhed by the form of their habits, or the diverfity of their colours.

QUADRILLE, a well-known game at cards; and which has been, in feveral cafes, the object of mathematical computations. See *M. De Moivre's Doctrine of Chances*, 3d edit. p. 97, &c.

QUADRIO, *FRANCESCO SAVERIO*, in *Biography*, a Jefuit, author of a voluminous hiftory and defcription of every kind of Italian poetry, "*Della ftoria e della Ragione d'ogni Poefia*," eight vols. 4to. published at Bologna between the years 1739 and 1752.

The author feems a mere compiler, without felection,

taste, or accuracy. It is a heavy work, hardly interefting enough to ftimulate a regular perufal; and from the diforder of arrangement, very difficult to confult. *Crefcimbeni* is as fuperior to *Quadrio* in every requifite of an hiftorian of literature, as *Tirabofchi* is to *Crefcimbeni*.

QUADRIPARTITION, the dividing by four; or a taking of the fourth part of any number, or quantity.

Hence *quadripartite*, &c. fomething divided into four.

QUADRIREME, *QUADRIREMIS*, a galley, or vefel, with four oars on a fide; the invention of which was attributed by the ancients to the Carthaginians.

QUADRISSETÆ, the four-haired flies, a term ufed by the writers in natural hiftory to exprefs thofe flies of the feticaude or hair-tailed kind, which have four hairs or briftles growing from the tail, as the others have three, two, or one.

QUADRIVIVUM, the centre of four ways, where four roads meet and crofs each other. By ftatute, pofts with infcriptions are to be fet up at fuch crofs-ways, as a direction to travellers, &c. 8 & 9 W. III. c. 10.

QUADRIVIVUM, befides the centre of four ways, was a fcholafic divifion, ufed in the middle ages in our univerfities, to exprefs the higheft clafs of philofophical learning and fcience; comprehending arithmetic, geometry, aftronomy, and mufic: as the trivium did grammar, rhetoric, and logic. During this period, mufic, fuch as it was, muft have been highly prized to be ranked with the moft fublime fcience, and thought an effential part of a learned education.

QUADRO, Ital. literally means fquare, and in mufic, at prefent, it implies a natural, *q*, or Gothic B, in oppofition to *tondo*, round, or the round *b*, ufed for a flat. The durum hexachord is fometimes called the quadro hexachord, from the circumftance of B being *q*.

It was the opinion of Padre Martini and the prince abbot of St. Blafius, that accents and points, enlarged, diftigated, and lengthened, became mufical characters for time as well as tune. At firft, when lines and fpaces were ufed, from their being chiefly employed in a fquare form for writing the chants eftablifhed by St. Gregory, they acquired the name of Gregorian notes, quadrata, and in barbarous Latin, quadrigarta. As the church is flow in receiving new doctrines, and generally a century later in admitting thofe improvements or corruptions in mufic (the reader may call them which he pleafes) that are adopted by the laity as the fortunate efforts of cultivated genius, the notation of chants was at firft cenfured and prohibited by feveral councils; and figurative harmony being regarded as a crying fin by pope John XXII., was formally excommunicated by a bull from the conclave 1321. See *NOTES*, and *TIME-TABLE*.

QUADRUGATA TERRÆ, in *Old Law Records*, denotes a team-land; or fo much as can be tilled by four horfes.

QUADRULA, in *Natural Hiftory*, a word fometimes ufed in the fame fenfe as *tessella*, and fpoken of the cubic pyrites. Sometimes it is ufed alfo as the name of thofe little fpangles of fhining matter that are mixed among fand. Thefe are generally fragments of talc; and are of various colours, white, yellow, and blackifh.

Solinus has ufed the word *quadula* to exprefs the fragments of yellow talc that are found in that fand called *amochryfos*, or golden fand. He miftakes thefe fhining particles for mafles of real gold, and makes the fand itfelf a kind of precious fubftance ranked among the gems, and brought from Perfia; but in this he does not agree with the reft of the ancients.

QUADRUPED. The effential character of quadrupeds

peds is, that they have a hairy body and four feet, and that the females are viviparous, and give suck to their young.

Quadrupeds are distinguished, by the number of their feet, from other animals, which have only two feet, as birds; from those which have no feet, as fishes and reptiles; and from those which have more than two feet, as insects.

Aristotle distributes quadrupeds into three classes; denominating those whose feet are terminated by a hoof in one piece, *solipedes*; those which have a cloven hoof he distinguished by the name of forked or cloven-footed; and those whose feet are digitated he called *ffiffipedes*. With this general division he contented himself, without descending to a methodical distribution of each class into their several orders, genera, &c. Gefner, Aldrovand, Jonston, and many other naturalists, have adopted the distribution of Aristotle; but we are indebted for the regular systematic arrangement of quadrupeds to Mr. Ray, who published his "Synopsis Methodica Animalium Quadrupedum et Serpentinum generis," &c. in 1693. According to this writer, quadrupeds are divided into those which are hoofed, *ungulata*; and those which are clawed, or digitate, *unguiculata*.

QUADRUPEDS, *Hoofed*, are either,

1. *Whole-hoofed, solipeda*, *μωσχολα, μωνυχια, solidungula*; as the horse and ass, the onager or wild ass, the mule; and the zebra of Africa, or the fine striped Indian or African ass, almost like a mule in form and stature.

Of the whole-hoofed kind, Aristotle has observed, that no one hath two horns (he might have said any horns); no one hath the talus, or astragalus; nor have the males any appearance of teats.

2. *Cloven-footed*: and that either, 1. Into two divisions only; as the *διχyla*, or bifurcate kind; which are again subdivided into such as are,

First, *Ruminant*, *μνησκαζοντα*, that is, such as chew the cud; and these either have hollow and perpetual horns, as the bull, sheep, and goat kind; or deciduous horns, as the hart and deer kind, which usually shed their horns annually.

Of the *bull* kind are reckoned these; the common bos or bullock, of which the male is taurus, the female vacca; the German urus, urochs, or aurochs; the bison; the bonafus; the bubalus, or buffalo; and the bos Africanus of Bellonius, Obs. lib. ii. c. 50. which he takes to be the bubalus of the ancients.

Of the *sheep* kind, besides the common sort, are reckoned the Arabian ovis laticauda, whose tail is sometimes of thirty pounds weight; the ovis strepticeros Cretica Bellonii; the ovis Africana, with short hair instead of wool; and the ovis Guineensis, or Angolenfis, of Marcgrave, Hist. Brasil. lib. vi. c. 10.

Of the *goat* kind are, besides the common capra domestica, the ibex, or German steinbock, found on the tops of the alps; the rupicapra, French chamois, or German gems; the gazella Africana, or antelope; the gazella Indica; the gazella Africana with shorter, annulated, and bent horns; the capra sylvestris Africana Grimmii; the capra Mambrina, or Syriaca of Gefner; the bucephalus, or moschelaphus Caii, in Gefner; the tragelaphus Caii, in Gefner; and the tragelaphus of Bellonius.

Of the *hart*, or *deer* kind, are reckoned, the cervus, *ελαφος*, or red deer; the cervus platyceros, or palmatus, the fallow deer; alce, or the elk; rangifer, the rein deer; the axis Plinii, according to Bellonius; the caprea Plinii, the cuguacu-ete, and cuguacu-apara, of Marcgrave; the caprea Groenlandica.

Secondly, of animals whose feet are divided into two parts only, and which do not chew the cud, there is only the hog and swine kind. Under this head, besides the com-

mon swine, are reckoned the wild boar, or swine; the Guineensis Marcgravii; the porcus Indicus, or babyroussa; the tajacu or aper Mexicanus moschiferus of Dr. Tyson, called, by Marcgrave, tajacu caaigoara; by others, quauhtla coy-matl, and quapizotl; and by Acosta, and some others, zaino.

2. There are some quadrupeds, whose hoof is cloven into four divisions, and these seem to be not ruminant; as the rhinoceros, the hippopotamus, the tapijere of Brasil, the capy-bara of Brasil, and the animal moschiferum.

QUADRUPEDS, *Clawed or Digitate*. Of this kind, there is, first, a sort whose claws are not divided or separated, but adhere to one another, and are covered with one common skin, but with obtuse nails, sticking out round the margin of the foot; as the elephant, which is anomalous, and not clearly referrible to this kind, or to that of cloven-footed quadrupeds.

A second species of this digitate kind of quadrupeds, which has only two claws, is the camel; and though these have no horns, they both ruminate, and have also the four stomachs of horned ruminant animals.

Of the camel there are two sorts; one having but one hump on the back, the other two.

To this kind also belong the Peruvian glama, which some have reckoned among the sheep kind; as also the pacos, the ovis Indica, or Peruviana vulgo, which is much less than the glama.

A third species of this unguiculate kind includes such animals as the Greeks called *Πλατωνυχια*, and *Ανθρωπομορζα*, which have the foot divided into many claws, with broad nails on them; as the ape and monkey kind.

Of these, some have no tails, and are called simiæ, or apes: others have tails, and are called monkies, cercopithecii; and such as have either long or short tails, if they are of a larger size, are called papiones, or baboons. There are great numbers and varieties of this species of quadrupeds; of which naturalists have described these, viz. the orang-outang, or homo sylvestris of Dr. Tyson, described by him in a particular discourse; the guariba of Brasil, Marcgravii; the cagui of Brasil, greater and lesser; the cay of the same region, described by Leriux; the caitaia of the same country; the cercopithecus barbatus Guineensis, two or three sorts of it; the cercopithecus Angolenfis major; the cercopithecus non barbatus Clusii; the cercopithecus Clusii, called sagouin. Lastly, if apes and monkies have their snouts very prominent, like dogs, they are called cynocephali.

A fourth species of this unguiculate kind is, when, though the claws are many, yet they are not covered at the end with broad flat nails, like monkies or apes; but are rather like the talons of hawks, &c. crooked and sharp-pointed.

These, in respect of their teeth, may be divided into such as have many dentes primores, or incisores (that is, cutting teeth) in each jaw, of which there are two sorts; a greater, which either have a short, round head, as the cat kind; or a lesser sort, having a long slender body, with very short legs, as the weasel or vermin kind. There are also some of this species of quadrupeds which have only two large remarkable teeth in each jaw: these are the hare kind; and these live only upon herbs, grafs, &c.

Of the *cat* kind of quadrupeds are reckoned to be the lion; the tyger; the pardalis, whose male is pardus, and female panthera; the leopard; the lupus cervarius, or lynx; the catus pardus, or cat-a-mountain; the common cat; and the bear.

Of the *dog* kind are reckoned the wolf; the lupus aureus, or jackall; besides the common dog, of which kind they

they enumerate the mastive, or mastiff; the canis venaticus Graius, Græcus, or Scoticus, the greyhound; Graius Hibernicus, or the Irish greyhound; the canis venaticus sagax, indagator, fectator ferarum, &c. the hound; canis venaticus Hispanicus, or aviarius, the spaniel for land or water; vertagus, or tumbler; canis Okeny, or domesticus, the house-dog; canis melitæus, or the lap-dog; canis Getulus, or Islandicus, the shock: and of all these sorts there are many varieties of mongrels, and hybridous breeds.

Other species of the dog-kind are, the fox; the animal zibethicum, or civet-cat, as it is corruptly called, but by its teeth and snout is plainly of the dog-tribe; the American coati, or rackoon, or rattoon; the yzquepatl; the carigueya, maritucaca, carigoy, ropoza, or opoffum; the taiubi; the taxus, or meles, the badger, grey, or pate; the lutra, or otter. To these some add the phoca, sea-calf or seal; the equus marinus, morse, or sea-horse, mistaken by some for the hippopotamus; the Dutch call him walrus, the Danes and Icelanders rosmarus; lastly, the manati, or vacca marina, the sea-cow.

Of the *vermin*, or *weasel* kind of quadrupeds, is, first, the mustela vulgaris, the common weasel, in Yorkshire called founart, or fitchet, γυλῆν: the viverra Indica, called quill and quirpele; another sort called mungo, and mungathia, of a reddish-grey; the mustela, ermine, or stoat, and mustela sylvestris, the ferret; putorius, the pole-cat; martes, or foyna, the martin, or martlet; mustella zibellina, the sable: lastly, the genetta; and the ichneumon Bellonii.

Of the *bare* kind of quadrupeds are, first, lepus, or the common hare; cuniculus, the rabbit, or coney; tapeti, or Brasil coney, and the aperea of Brasil; the hystrix, or porcupine, and the hystrix Americanus, or cuanda of Brasil; castor, fiber, or the beaver; sciurus vulg. or squirrel; the Virginian, Zeylandic, Barbary, and American flying squirrel; mus domesticus, major and minor, the common rat and mouse: to these also may be referred mus major aquaticus, the water-rat; the musk-rat, mus avellanarum, major and minor; the dormouse or sleeper, mus Noricus, Cricetus, Alpinus, seu marmotta; the cavia cobaya, or cuniculus Americanus, the Guinea-pig; the aguti, and paca of Brasil; the mus Norvegicus, or leming; the glis Gefneri, or the rell; the mus Indicus, &c.

QUADRUPEDS, *Anomalous*. To these several kinds, the following anomalous ones must also be added:

1. Such four-footed viviparous animals as have a longish snout, with their feet divided into many claws, and toes, and having teeth; as the echinus terrestris, or common urchin, or hedge-hog; erinaceus Indicus albus; tatu or armadillo prima of Maregrave; tatuete of Brasil, or the second species of the armadillo, according to Maregrave; tatu apara, his third species of armadillo; tatu muselinus, Soc. Reg. Mus. the weasel-headed armadillo; talpa, the molewarp, or moldwarp; and the mus araneus, threw, hardy threw, threwmouse.

2. Quadrupedous and viviparous animals with a longish snout, having their feet divided into many claws or toes, but without teeth; as the tamandua guacu of Brasil, Maregravi, ursus formicarius Cardani, the great ant-bear; the tamandua of Brasil, or Maregrave, the lesser ant-bear.

3. Anomalous flying quadrupeds, with a shorter snout, and their feet divided as above; being of the bat-kind, or flitter-mice, of which there are several sizes, and of different forms.

4. There is one very anomalous animal, which has but three claws on each foot; and that is the ai or ignavus of Maregrave, the sloth or sluggard.

5. Viviparous and sanguineous quadrupeds, breathing with lungs, but having only one ventricle in the heart; as the rana aquatica, the frog, or froth; rana arborea, seu ranunculus viridis, the small tree or green frog; bufo, five rubeta, the toad; testudo, the tortoise, in Greek χελωνη; of these there are land and water ones, and many different species in foreign parts.

6. Oviparous quadrupeds, with a long tail stretched out horizontally. Such are the lizard-kind; as lacertus omaium maximus, the crocodile; cordylus, five caudiverbera, uromastrix Græcis, larger than the green lizard; tapayaxin Novæ Hispaniæ, or lacertus orbicularis of Hernandez; lacertus vulgaris, the common eft, swift, or newt; lacertus viridis, the green lizard; lacertus fucetanus Aldrovandi, at Rome and Naples called the tarantula; lacertus Indicus, called fenembi and iguana; lacertus Brasiliensis, called tejuguacu, and temapara by Maregrave; the taraguira amciva, taraguico Arcuraba, Americima, Curapopeba, Teiunhana, &c. of Maregrave; the lacertus Indicus; the scincus, or crocodilus terrestris; the seps, or lacerta chalcidica, a kind of footed serpent; stellio, the swift, or spotted lizard; salamandra, called the salamandra aquatica, the water-est, lacerta volans Indica; and the chamæleo, orameleon.

This system of Mr. Ray obtained very generally among naturalists, till, in the year 1735, Linnæus first published his system. This was followed by several others, varying in the arrangement of the animal kingdom, even to the last edition of 1767. Under the class, which he denominates *Mammalia*, (which see,) he comprehends not only all the animals which we call quadrupeds (the lizard genus, or rather the reptiles pedati excepted), but also the cetaceous order, or whales, cachalots, and porpoises: justifying this arrangement of whales with quadrupeds, from the agreement of these animals in the structure of the heart, in the respiration by means of lungs, in their having moveable eye-lids and ears, in being viviparous, furnished with teeth, and other particulars, by which they differ so materially from fishes, as more than to counterbalance their living with them in the same element. The mammalia are divided into seven orders, the distinctions of which are principally established on the difference in the numbers, situation, and form of the three kinds of teeth, viz. the primores or incisores, called fore-teeth, or cutting-teeth; the lanarii or canini, called dog-teeth, canine or lacerating teeth; and the molares, double teeth or grinders. But Linnæus does not entirely neglect the feet. See the characters of the several orders under PRIMATES, BRUTE, FERÆ, GLIS, PECORA, BELLUA, and Cete or WHALE. This part of the Linnæan system, including a few species described in the Appendix of the third tome, and in the Mantissa of 1771, contains about two hundred and thirty species.

Mr. Pennant, in his "Synopsis of Quadrupeds," and professor Martin, in his "Elements of Natural History," by including some animals that were unknown to Linnæus, and giving the rank of species to several that were considered by him as varieties, have extended the number of mammalia to two hundred and eighty-nine species. Mr. Klein, in 1751, published a new system of quadrupeds, intitled "Quadrup. Dispositio brevifque Hist. Natur." in which he distributes them into two orders, the first comprehending those whose feet are terminated by one or more hoofs, and the second those which are digitated; and each of these orders is subdivided into five families or classes. In his first order he follows the general arrangement of Mr. Ray, which he has considerably improved: but in the second, by a fervile regard to a method founded on the number of toes, he has combined very opposite animals; the camel and the sloth, the mole and the bat,

bat, the glutton and apes. Mr. Buffon, in 1756, published another system, in which he has arranged animals by the number or defect of their teeth; beginning with those that are toothless, such as the ant-eater, and ending with those that have the greatest number, such as the opossum. By this arrangement, some quadrupeds, very distant from each other in their manners, are too nearly connected. We shall say nothing of Mr. Buffon's "History of Quadrupeds," though it contains much valuable information, because he seems to have disregarded systematic arrangement. Mr. Pennant has introduced some useful alterations in his "History of Quadrupeds;" this ingenious naturalist has followed Mr. Ray in his greater division of animals into *hoofed* and *digitated*; but, after the manner of Mr. Klein, he has formed separate genera of the rhinoceros, hippopotamus, tapir, and musk. The apes are continued in the rank in which Mr. Ray placed them, and are followed by the maucaucos. The carnivorous animals are arranged according to the system of Linnæus, omitting the seal, mole, shrew, and hedge-hog. The herbivorous or frugivorous quadrupeds occupy the class assigned to them by Mr. Ray, to which he has allotted likewise the shrew, the mole, and the hedge-hog. The fourth section of digitated quadrupeds consists of those which are absolutely destitute of cutting teeth, such as the sloth and armadillo. The fifth section is formed of those which are destitute of teeth of every kind, such as the manis and ant-eater. The third and fourth orders or divisions which Mr. Pennant has added, are the *pinnated* and the *winged* quadrupeds: the first comprehends the walrus, the seals, and (in conformity to preceding writers) the manati. But these, he observes, seem as the links between the quadrupeds and the cetaceous animals. The bats are winged quadrupeds, and form the next gradation from this to the class of birds. See Pennant's *Hist. of Quadrupeds*, ed. 8vo. 1781. Preface. See CLASSIFICATION.

QUADRUPEDS, Alated. Among the many fabulous things with which natural history has been loaded, stories of flying quadrupeds seem to claim a very high rank; the gryphon, the quadruped dragon, and a great many other imaginary animals, having been introduced so seriously among the descriptions of real animals, that too many have been taught to believe them. Scheuchzer, in his "*Physica Sacra Jobi*," has done much toward discountenancing such relations; and Hyacinthus Gemina, who has written expressly "*De Fabulosis Animalibus*," has added much on the same occasion; yet all is not done. The world have late histories of lemmas and basilisks, which never existed but in the imagination of the relator, or in the subtle contrivance of the fabricator; as is evidently the case in the basilisks which we find in the museums of the curious, and which are all made out of the ray-fish. And the generality of readers are so fond of any thing that is marvellous, that these things are sure to be remembered, while perhaps all the truths in the book are forgotten.

Upon the whole, the standard of the flying or alated quadrupeds seems to be properly enough reducible to this: that the words flying and alated are not synonymous terms, and that there are three kinds of flying among the quadruped class. The first absolute and swift, flying as perfect as in birds: this peculiarly belongs to the bat; which is the only alated or winged quadruped, properly speaking. 2. An imperfect flying by means of certain membranes serving as wings, but imperfectly, and not turning quick, or enduring long flights: such is the flying of the lizard, which is not properly an alated animal. And lastly, the imperfect flying of the squirrel kind, which even in that species called, by way of eminence, the flying squirrel, is

not properly flying, but only long leaping; the creature being able to turn but very little out of a right line, and only to suspend itself during a short time in a leap from a high place to a lower. Phil. Trans. N° 247. p. 34.

QUADRUPEDS, in Agriculture, all such animals as walk on four legs, and are of the domestic kind, as horses, neat cattle, sheep, swine, and many other sorts, which are beneficial either for the purposes of working, fattening, or in any other way. Some animals of this nature are disposed for one of these purposes in preference to others; while others are capable of being made to serve more than one of them. Thus, horses of the lighter and more active kind are adapted to the saddle, and some sorts of road work, and those of the more heavy sort to all descriptions of team work in the field or other places. And neat cattle of the ox kind, in the less heavy breeds, as the Devonshire, Herefordshire, and some others, are well suited to team labour as well as fattening; while those of the more heavy sorts, as the Lancashire breed, or long horses, &c. are better calculated for feeding only. Among sheep, some breeds are valuable for their mutton as well as their wool; some for the former, or latter, of these articles only; and others again for their ready disposition in taking on flesh. In swine, some breeds are much better formed than others; require much less food, in proportion to their sizes, in keeping and fattening, and are more disposed to feed, &c.

The same is likewise the case with some other animals of this description, which should constantly be taken into the account in selecting and choosing them for the use of the farmer.

Quadrupeds of all sorts, should also, in all cases, be well adapted in their numbers, natures, and kinds, to the qualities of the lands as farms, their extents, and the quantities of labour to be performed upon them, as much in the success of farming depends on this being properly done. They should likewise be constantly well kept and in proper condition, according to the different intentions for which they are designed, as badly fed or half-starved animals never answer any good purpose for the farmer, they always requiring a much larger proportion of food for restoring or bringing them again into proper order and for fattening them, than would otherwise have been necessary; and they never ultimately turn out so well, or produce so much advantage, as might have been the case under other circumstances. And, in labouring animals, where this is the case, they are never capable of performing nearly so much work, in consequence of which a vast continual loss is sustained, though scarcely perceived. See *LIVE-Stock*, and *TEAM*.

QUADRUPLES, among the Romans, were informers, who had the fourth part of the confiscated goods for their pains.

QUADRUPLE, a sum or number multiplied by four, or taken four times.

QUADRUPLE is particularly used for a gold coin, worth four times as much as that of which it is the quadruple.

The quadruple of the Spanish pistole is a piece of four pistoles, called also the *double doubloon*.

The quadruple of the louis d'or is a piece of gold coined in the reign of Louis XIII. in 1641. The legend on one side is CHRISTUS VINCIT, REGNAT, IMPERAT: and on the middle of this side it has a cross with four crowns, and cantoned in four fleurs-de-lis; on the other side it has the legend, LUDOVICUS DECIMUS TERTIUS DEI GRATIA FRANCORUM REX, with the head of Louis XIII. Its value under this king was twenty livres.

QUADRUPLE Croche, in *French Music*, is a note with four hooks or four ties, one degree quicker than our demi-semiquaver,

femiquaver, and for which we have no name. The term *croche*, in French a quaver, is not derived from *crotchet*, but from the tail being *crooked*. And why our crotchet, with a *straight tail*, has its name, is a whimsical absurdity, for which we are unable to account.

QUÆ *est eadem*, in *Pleading*, is used to supply the want of a traverse. (2 Lill. Abr. 405.) In a *clausum fregit* such a day, the defendant pleads the plaintiff's licence to him to enter on the same day, and that *virtute inde* he entered; he need not say, *quæ est eadem transgressio*.

QUÆ Plura, a writ that anciently lay where inquisition had been made by an escheator, of such lands or tenements as any man died seized of, and all was supposed not to be found by the office or inquisition.

This writ was to inquire what more lands or tenements the parties died seized of. But it is now made useless, by taking away the courts of wards and offices post mortem.

QUÆ Servitia. See PER *quæ servitia*.

QUÆRENS *non invenit plegium*, a return made by the sheriff upon a writ directed to him with this clause, viz. *Si A. fecerit B. securum de clamore suo prosequendo, &c.* F. N. B. 38.

QUAERNES, in *Geography*, a town of Norway; 55 miles N. of Romfald.

QUÆSTA, in our *Ancient Writers*, denotes an indulgence, or remission of penance, exposed to sale by the popes.

QUÆSTIONARIÏ, in our *Ancient Law Books*, were people who went about with indulgences from door to door, desiring charity either for themselves or others.

Matt. West observes, 1240, that the king, "Terram suam per papale questionarios, depauperari, &c. permittit."

QUÆSTOR. See QUESTOR.

QUÆSTUS, in *Law*, is that estate, or those effects, which a man hath by acquisition or purchase; in contradistinction to *hæreditas*, which is what he hath by descent. See ACQUEST, and GOODS.

Glanv. lib. vii. "aut habet hæreditatem tantum, vel quæstum tantum, aut hereditatem & quæstum."

QUAG, in *Agriculture*, a name given to any sort of wet, swampy, morassy, or boggy situation in land, which has a tremulous or shaking feel under the foot, and which produces nothing but a coarse grassy herbage that is unfit for the food of animals. Low as well as high grounds are subject to spots of this kind wherever water is confined and retained near the surface. They are to be removed by proper means of draining, and the application of solid earthy matters of different kinds upon the surfaces of them, with the use of rollers in order to consolidate the whole. See BOG and SWAMP.

QUAGGA, in *Zoology*. See EQUUS.

QUAGLIATI, PAOLO, in *Biography*, the music-master of the celebrated traveller, Pietro della Valle, at Rome, in the beginning of the 17th century. His disciple, della Valle, says, "that he was an excellent maestro di cappella, who introduced a new species of music into the Roman churches, not only in compositions for a single voice (*monodie*), but for two, three, or four, and very often more voices, in chorus, ending with a numerous crowd of many choirs or chorusses, singing together; specimens of which may be seen in many of his motets that have been since printed. And the music of my *cart*, or moveable-stage, composed by the same Quagliati, in my own room, chiefly in the manner he found most agreeable to me, and performed in masks through the streets of Rome during the carnival of 1606, was the first attempt at an opera, or secular drama in music,

which had been heard in that city." See OPERA, RECITATIVE, and PIETRO DELLA VALLE.

QUAGMIRE, in *Agriculture*, the name of a sort of soft miry shaking or quaking bog, swamp, or morass, which is frequently and commonly met with in low hollow situations, where there is none, or very little descent, for the discharge of the stagnant water or wetness. They are formed in many different ways according to the nature of the circumstances which first gave rise to them, and that of the places in which they are found. The author of the "Treatise on Landed Property" has remarked, that besides the common moory quagmires or bogs, there is a species which is constantly charged with moisture, yet does not accumulate a thick covering of moory earth, owing probably, it is supposed, to the want of fertility in the water by which it fed. These sorts of quagmires are, in his opinion, for the most part, found in mountainous and hilly situations. Other kinds are occasionally seen on large peat mosses, and hollow meadows, in spots where the water is confined and kept up nearly to their upper parts, and where there is much decay of vegetable productions on their surfaces, and the reception of earthy materials from other places. These quagmires occupy large spots of ground in many different situations, and are, of course, a great loss to individuals and the public, as little or nothing of any use is ever produced by them. (See MORASS.) They are, for the most part, capable of being readily drained by proper means, a sort of improvement which ought never to be neglected where it can be performed with any chance of success.

QUAHU, in *Geography*, a district of Africa, on the Gold Coast, in the kingdom of Acambou, or Aquamboe; which see.

QUAHVITLA, in *Botany*, a name used by some authors for the tree from which the resin commonly called gum copal is procured.

QUAICHA, in *Geography*, a town of Africa, in Senaar; 38 miles E.S.E. of Gessim.

QUAIL, COTURNIX, or Tetrao coturnix of Linnæus, in *Ornithology*, the least of all the birds of the gallinaceous kind. They have, however, the genius of the cock kind, and may be bred to fight like our game cocks.

This was an old custom among the Athenians, and is still kept up in some parts of Italy, and in Asia.

Quails are birds of passage, some entirely quitting our island, others shifting their quarters from one county to another, and sheltering themselves among the weeds near the sea-side; with us they frequent the corn-fields, and sometimes the meadows. They begin to sing in April, and make their nests in the month of May, building on the ground, and seldom lay more than six or seven whitish eggs, marked with ragged rust-coloured spots.

Quails are to be taken by means of the call during their whole wooing time, which lasts from April to August. The proper times for using the call are at sun-rising, at nine o'clock in the morning, at three in the afternoon, and at sun-set; for these are the natural times of the quail's calling. The notes of the cock and hen-quail are very different, and the sportsman who expects to succeed in the taking of them, must be expert in both; for when the cock calls, the answer is to be made in the hen's note; and when the hen calls, the answer is to be made in the cock's. By this means they will come up to the person, so that he may, with great ease, throw the net over them, and take them. If a cock-quail be single, on hearing the hen's note he will immediately come; but if he have a hen already with him, he will not forsake her. Sometimes, though only one quail answers to the call, there will three or four come up; and

and then it is best to have patience, and not run to take up the first, but stay till they are all entangled, as they will soon be.

The quail is a neat cleanly bird, and will not run much into dirty or wet places: in dewy mornings they will often fly instead of running to the call; and in this case, it is best to let them go over the net, if it so happens that they fly higher than its top, and the sportsman then changing sides, and calling again, the bird will come back, and then will probably be taken in the net.

The calls are to be made of a small leather purse, about two fingers wide, and four fingers long, and made in the shape of a pear; this is to be stuffed half full of horse-hair, and at the end of it is to be placed a small whistle, made of the bone of a rabbit's leg, or some other such bone; this is to be about two inches long, and the end formed like a flageolet, with a little soft wax. This is to be the end fastened into the purse; the other is to be closed up with the same wax, only that a hole is to be opened with a pin, to make it give a distinct and clear sound. To make this sound, it is to be held full in the palm of the hand, with one of the fingers placed over the top of the wax: then the purse is to be pressed, and the finger is to shake over the middle of it, to modulate the sound it gives into a sort of shake. This is the most useful call; for it imitates the note of the hen-quail, and seldom fails to bring a cock to the net, if there be one near the place.

The call that imitates the note of the cock, and is used to bring the hen to him, is to be about four inches long, and above an inch thick; it is to be made of a piece of wire, turned round and curled, and covered with leather; and one end of it must be closed up with a piece of flat wood, about the middle of which there must be a small thread or strap of leather, and at the other end is to be placed the same sort of pipe, made of bone, as is used in the other call. The noise is made by opening and closing the spiral, and gives the same sound that the cock does when he gives the hen a signal that he is near her.

QUAKERS, in *Ecclesiastical History*, the common denomination of a society of Christians, who appeared first in England about the middle of the seventeenth century, and who continue to be distinguished from others by peculiar tenets and practices. They call themselves *Friends*. They are remarkable for asserting the continuance, to the present time, of immediate revelation, or the communication of divine instruction to the mind, by the testimony of the spirit of God. This revelation they affirm to be necessary for the production of true faith, and that it neither does nor can contradict the outward testimony of the scriptures, or right and sound reason. Their doctrine on this subject has been often misunderstood, even by theological writers; and they have in consequence been subjected to much obloquy. It is, however, the principal feature in that peculiar view of Christianity, which has occasioned their separation from other churches.

Origin and History.—Before the period above mentioned, many serious persons, satisfied with none of the modes of religion which the reformation brought forth, had withdrawn from the communion of every visible church, to cultivate in retirement, impressions which they attributed to the operation of the spirit of Christ on their own minds: it is chiefly from such, when brought to recognize each other by the ministry of an individual, that the Quakers consider their society to have been originally gathered. George Fox, the individual in question, was born in 1624. He has left a journal of his own life, written with a simplicity of style,

which proves that he has fairly laid open his own character. In this work, the peculiar principles of Quakerism may be satisfactorily explored in their early beginnings, which it may be worth while briefly to review. Fox's parents, who were pious members of the church of England, had intended him for the priesthood, his character affording very early promise of fitness for religious service; but others persuading to the contrary, he was put under an innkeeper to a country business. Being engaged herein at a fair, when about the age of nineteen, a cousin of his, with another professor of religion, attempted to engage him in drinking to intoxication. "The Lord had shewn me," says George, "that I might not eat or drink to make myself wanton, but for health, using the creatures in their service, as servants in their places, to the glory of Him who created them."

Accordingly, on perceiving the design of his companions, he rose up, paid for the refreshment they had had, and departed, with emotions of virtuous indignation. Returning home, he passed a sleepless night, walking up and down, and crying to the Lord; who, he affirms, said unto him, "Thou seest how young people go together into vanity, and old people into the earth; thou must forsoke all, young and old, keep out of all, and be as a stranger unto all." The reader will understand this, and generally all revelations professed to have been received by Quakers, as consisting not in an outward voice, but in an internal communication to the mind. Taking the command literally, he detached himself from his connexions; and having some property of his own whereon to subsist, removed from place to place, observing the religion and professors of the age, without engaging in close fellowship with any. He devoted much of his time to fasting, solitary prayer, and reading the bible.

He became at length quite detached in his affections from the world, distressed at the spiritual condition of his fellow men, and in much anxiety, bordering on despair, about his own; yet was not without intervals of heavenly joy and comfort. Such a state of mind naturally led him to seek for spiritual counsel from others, and he had conferences with many of the clergy, beginning with his own parish priest. In answer to a question from the latter, we find him professing faith in Christ, who, by his death as man, (for he died not as he was God,) became an offering for the sins of the whole world. The general result of these conferences was, however, unsatisfactory to him; "for," he observes, "they could not reach my condition." Pursuing, therefore, his meditations on the subject as before, he came to be satisfied respecting several propositions which it involved, such as the following:—that although it was said that all Christians are believers, both Protestants and Papists, yet that none were truly such, but those who were born of God, and who had passed from death unto life. Again, that to be bred at Oxford or Cambridge, was not enough to fit and qualify men to be ministers of Christ. At this he wondered, because it was the common belief that such qualification was sufficient. "At another time," he says, "it was opened in me, that God, who made the world, did not dwell in temples made with hands. This at first seemed strange, because both priests and people used to call their temples or churches dreadful places, holy ground, and the temples of God; but the Lord shewed me clearly that he did not dwell in those temples, which men had commanded and set up, but in people's hearts." George Fox now ceased to attend the established preachers; at which his relations being offended, he shewed them from the scriptures, "that there was an anointing within man to teach him, and that the Lord would teach his people himself."

Observing,

Observing, as he thought, more of the fruits of this internal teaching among the "dissenting people," he went for a while among them; but, he continues, "as I had forsaken the priests, so I left the separate preachers also, and those called the most experienced people; for I saw there was none among them all that could speak to my condition. And when all my hopes in them, and in all men, were gone, so that I had nothing outwardly to help me, nor could tell what to do, then, O then, I heard a voice, which said, 'There is One, even Christ Jesus, that can speak to thy condition.' When I heard it my heart did leap for joy. Then the Lord let me see why there was none that could speak to my condition, namely, that I might give him all the glory. For all (he continues, alluding to Rom. xi. 32.) are concluded under sin, and shut up in unbelief, as I had been, that Jesus Christ might have the pre-eminence, who enlightens and gives grace, faith, and power."

The preceding is a specimen of Fox's own account of the manner in which the doctrine he afterwards preached arose in his mind. The reader will perceive that he refers all his real edification to the means which have been already indicated, immediate revelation. He says, "though I read the scriptures, that spoke of Christ, and of God, yet I knew *Him* not but by revelation, as he who hath the key did open, and as the Father of life drew me to his Son by his Spirit." Yet that he was sensible of the importance of the holy scriptures, as the source from whence, under this influence, Christian instruction must be drawn, is evident, both from his declaring that they were very precious to him, and from his having incessantly used, and constantly appealed to them, both before and after beginning to promulgate his system.

Having at length attained to a view of Christianity in which he found peace of mind, he believed himself required and divinely commissioned to become a teacher of it to others: and from the year 1647, the reader may conceive him always engaged in this office. He travelled as before, preaching first to small companies of enquiring persons, then to public congregations, such as upon his appearance among them were willing to hear him, and at length to large assemblies of people, convened on purpose. This he did with the courage and perseverance of a reformer; in the face of opposition from the national and stipendiary preachers, of frequent personal abuse from their hearers, and occasional severe treatment by the magistrates. In most places where he came, he met with persons who received his doctrines, a proportion of whom, after associating with him for a time, became impressed with the like apprehensions of duty to propagate their principles; which they attempted by similar methods. Thus, although interrupted at different periods by imprisonment, he found himself, before many years had elapsed, in connection with a numerous band of fellow-labourers, and a widely diffused and respectable society of religious friends. No inconsiderable number of these quitted, for the sake of their principles, livings in the church, commissions in the army, or seats as magistrates.

When we consider that this happened in an age equally remarkable for religious zeal and political turbulence, it will appear that some deviations from Christian propriety, some fruits of the mixture of imagination with good intentions, could scarcely fail to be exhibited among them. If the new society, from a regard to its principle of internal impulses to particular duties, was slow to condemn these, it was careful, on the other hand, not to engraft them, by imitation on its practice. Individuals, therefore, were alone responsible for such acts, and the general conduct of the members, from the period of their first associating together,

was found in no mean degree conformable to the morality of the gospel.

The most serious instance of misconduct occurred in the case of James Nayler and his followers. This fell out in 1656, and was magnified beyond its real importance by being suffered to occupy for ten days the attention of parliament. Nayler had been an Independent, and a quartermaster of horse under major-general Lambert. He was one of George Fox's earliest converts, and for some years an able preacher and disputant in the same cause. Coming to London, he found a set of people who extolled him in his office above measure. His friends, and George Fox among the rest, seeing his danger, gave him suitable cautions; but slighting these, he became exposed to the flatteries of a train of followers, chiefly women, whom he suffered, at length, from a delusive notion of its being done to *Christ in him*, to address him with the name and titles of the Saviour, and with acts amounting to worship. In particular, his entrance into Bristol was conducted, by these infatuated people, in imitation of the procession of Christ into Jerusalem. The parties implicated in this transaction were committed to prison; but Nayler alone was selected by parliament, after examination and long debates on his case, for punishment as a blasphemer. Cromwell kept aloof from the proceedings, which, by their excessive severity, moved great commiseration in the public. The culprit was twice scourged through the streets, twice pilloried, branded in the forehead, and bored through the tongue with a hot iron: all which he endured with surprising patience and fortitude. His punishment ended with two years' close imprisonment in Bridewell, during which he attained to repentance, and a sounder mind. Having given proof of this by several public confessions, the Quakers, who had disowned both him and his followers, received him back into their communion, in which he lived circumspectly the short remainder of his life.

Quakerism prevailed at first chiefly in the northern counties; but many preachers having risen up here, who travelled in different directions, it was not long in spreading to the metropolis, and the remoter southern and western parts. Wherever its professors appeared, the ordeal of suffering awaited them; for which their negative tenets commonly furnished the occasion. They refused to the priests every kind of payment, to the government military service, to the magistrate oaths, and to all persons the customary, and at that time much looked for *worship*, of kneeling or bowing with the head uncovered. They adhered too, in every instance, to their northern English of *thou* and *thee*, judging the plural mode of addressing one person to have originated, together with all empty titles, in a spirit of flattery unbefitting Christians. These peculiarities were a check to superficial conversions; since an upright conformity to the profession was in most cases purchased by the loss of friends, contempt, and hardships. Even the privilege of meeting to worship, apart from the national congregations, was acquired only by persevering in the practice, through almost every kind and degree of coercive obstruction, down to the period of complete toleration, the revolution of 1688. Hence their history consists in great part of a detail of buffeting, imprisonments, and spoiling of goods. So early as 1659 they stated to parliament, that in the preceding six years about two thousand individuals had suffered in person and estate, for being Quakers: and this representation was accompanied by one of the most extraordinary public acts on record. One hundred and sixty-four Friends offered themselves by name to the house, to be imprisoned in the places of an equal number, who from sickness or the hard-

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ships of their confinement, were conceived to be in danger of perishing. The house, however, rejected this proposal, and expressed some displeasure at "the reflections on magistracy and ministry," said to be contained in the memorial. It will be proper to give some particular instances of their sufferings.

James Parnel, a youth of good parts and education, going to see George Fox in a dungeon at Carlisle, became a convert to his principles: and, preaching in Essex, was the means of raising many congregations of Quakers in that county. He was imprisoned in Colchester castle, and at the age of nineteen sunk under the cruel treatment there inflicted on him. In 1656, two Quaker women arrived at Boston, New England. They were apprehended ere they could land, committed to close prison, and searched in a brutal manner, by stripping them naked, lest they might also be *witches*; an object to the colonists of equal and equally rational dread. These two, with eight others who arrived afterwards, were forcibly sent away: but the precaution was in vain, their principles entered the colony. An aged citizen, and church member of Boston, was first found favourably inclined to them; he was fined, imprisoned, and banished in the depth of winter. In Rhode island he was hospitably received by an Indian chief, who offered, if he would live with him, "to make him a warm house;" observing, "What a God have the English who deal so with one another about their God!" So far is intolerance from recommending the religion of those who practise it. Penal laws against Quakerism soon followed the appearance of this people in New England. The scourge was first applied, without regard to age or sex: mutilation, by cutting off the ears, followed: but these being found insufficient, cruelty proceeded through another intermediate step, banishment on pain of death, to its dreadful extreme; and four Quakers were hanged at Boston. Their names were William Robinson, Marmaduke Stevenson, William Leddra, and Mary Dyar. Their cases, as related by Sewel, in his "History of the Quakers," form an interesting piece of martyrology.

Charles II., on notice of these proceedings, granted a mandamus, which prevented further executions in the colonies; but he was not equally ready to restrain persecution at home. The Quakers had several meeting houses in London. When assembled at these, they were often dispersed by soldiers, under the direction of the magistrates; these effected the purpose by severe beatings with their arms. One John Trowel being evidently mortally wounded in this way, a coroner's inquest was held, but the verdict of the jury was suppressed: and the king, on being informed of the facts, evaded interference, telling the complainants to prosecute the law against the soldiers! Similar proceedings took place at Colchester; where the congregation, being kept out of their house, met for many weeks in winter standing in the street. Here they were assailed by soldiers on horse-back, who wounded many of them, and a man of seventy lost his life in consequence. On one of these occasions a trooper's sword, by violent using, came out of the hilt. The man he had been beating handed it up to him with these words, "I desire the Lord may not lay this day's work to thy charge." In this instance, as in others, the patience of the sufferers at length triumphed, and they were quietly allowed their right of meeting.

In 1665 a hundred and twenty Quakers were in Newgate, sentenced to transportation, under an act recently made "to prevent and suppress seditious conventicles." The masters of ships generally refusing to carry them, an embargo was laid, and it was made a condition of sailing to the West

Indies, that some Quakers should be taken thither by every vessel. A mercenary *wretch* being at length found for the service, the Quakers, unwilling to be active in their own banishment, refused to walk on board, as did also the seamen to hoist them in. By the help of soldiers from the Tower, fifty-five of them were at length shipped. But the master was now in prison for debt; and the ship, after seven months' detention, quitting the coast, was immediately taken by a Dutchman, and twenty-eight of the prisoners (the remainder having died of the plague) were liberated in Holland and sent home. Other parties of Quakers were set on shore again from different vessels, so that the number actually sent to the West Indies was small.

The preceding instances may serve to shew the kind of persecution which this society endured for many years; it may be observed in conclusion, that the court (or rather the clergy) of Charles, in their eagerness to suppress the growing society, actually descended to the measure of issuing a formal order of council for demolishing their meeting-house in Southwark, which was addressed to no less a person than Christopher Wren, esq. surveyor-general of his majesty's works; but it was executed by the military, by whom the congregation, who had the courage to meet on the ruins, were dragooned as often as they assembled, for nearly three months together, without however overcoming their firmness.

Though the Quakers never sent out missionaries, in the manner of some other societies, we have seen that individuals went, under apprehensions of religious duty, to distant parts. Several of these visited Italy, where they did not conceal their dislike of superstition; and one John Love, being detained at Rome on this account, died (as it seems a violent death) in the prison of the inquisition. Catharine Evans, and Sarah Cheevers, after three years' confinement, and many sufferings in the inquisition at Malta, were released and returned to England. But the most extraordinary enterprize, in this way, was performed by Mary Fisher, a maiden, and one of the two who had been so ill treated at Boston. She, apprehending she had a message from God to sultan Mahomet IV. actually made her way from England to his camp before Adrianople, where she delivered, through his interpreters, what was on her mind, was treated with respect, and offered an escort to Constantinople, which she declined, and returned, as she had gone, alone and in perfect safety. A young man, named George Robinson, went, through still greater difficulties, to Jerusalem, where, speaking against the superstition of the pilgrimages, the friars procured him to be forced into a mosque, whence the Turks, on his refusing to turn Mahometan, led him out to be put to death, as for wilfully violating the place: but a sudden change taking place in their sentiments concerning him, he also was permitted to return.

In 1660 the Quakers held their first general meeting, for the care of their poor and other concerns of the society, at Skipton in Yorkshire; within a few years after which, meetings for discipline were established throughout England and Ireland, chiefly by the incessant personal labours and epistolary recommendations of George Fox. At this period the society received a considerable accession of respectability by the conversion of William Penn and Robert Barclay. The celebrated Apology of the latter gave the world an opportunity of fairly appreciating doctrines till then but partially known, and on this account the more decried: and the settlement of the Jerseys, and subsequently, of Pennsylvania, under the auspices of Penn, opened to the Quakers a new and promising field of increase, which they did not fail speedily to occupy. Another person of con-

siderable learning, George Keith, after associating with them for near thirty years, became the author of a schism, the circumstances of which it will be proper to notice. Keith was a native of Scotland, and educated at Aberdeen; he was imprisoned, as a Quaker, in 1664, and in 1675 afflicted Barclay in a public disputation against the students at Aberdeen: he wrote much in defence of the principles of the Quakers, which he thoroughly understood, and was employed in the education of their youth; but is thought by them to have indulged too much in curious and useless speculations, which his brethren did not encourage. Being again repeatedly imprisoned, about 1684 he removed to America in disgust. Here, after some previous general censure of his friends, he accused several, in particular, of gross error in doctrine; the pretext for which was, their holding (as he himself had done) that the knowledge and belief of the history of Christ is not necessary for the salvation of those who have no possible means of acquiring it. His complaints against individuals leading to more general contention, the Friends in England interfered, and the parties were heard before the yearly meeting in London, which decided the cause against Keith, and he remained under the "disfowment" pronounced against him in America. He now set up a separate Quakers' meeting in London, attacked the principles he had formerly defended, (on which occasions the Quakers replied by quotations from his own works,) and finally entered into the church of England. He was soon after ordained priest, and made a missionary to America, to bring over his former brethren. But his efforts, though for a while troublesome to the Quakers, were attended with very little success: he returned to England, sunk into obscurity on a small living in Suffex, and his party gradually disappeared.

The jeopardy in which the Quakers almost constantly stood on account of their principles, very early introduced them to an immediate intercourse with the throne; and they thus acquired the privilege, which they still exercise, of presenting public addresses to the king, by a deputation from their body, in a manner which does not violate their conscientious scruples. The accession of a new sovereign, the conclusion of a peace, or an impending war, have commonly drawn from them addresses, in which sentiments not unworthy of their Christian profession, are conveyed in simple but respectful language. And very recently (1814), they availed themselves of the presence in this country of the emperor of Russia, and the king of Prussia, to address each of these monarchs in favour of a perfect toleration in their respective dominions: in which they met with a favourable reception. Another great and interesting object, the abolition of the slave trade, has frequently brought them forward to government in this way. In the cause of humanity, as it regards the oppressed Africans, they have proved themselves strenuous and indefatigable: the reproach, even of holding a fellow man in slavery, was wiped away from the members of this society many years before the abolition of the trade was decreed, either in England or America. This was effected by their discipline; and it was made a part of this, in consequence of that view of Christianity, which regards every individual of the human race as a fit object of its benefits, and as entitled to the charitable regard which it inculcates. Much was done on the Negroes' behalf, in America, by Anthony Benezet, whose character is well known to the world; and by John Woolman, a minister of the society, whose writings discover a mind of uncommon purity, simplicity, and tenderness.

The Quakers as a body have been long relieved from actual persecution: yet they are still involved by their principles in

occasional trouble as individuals. The refusal to bear arms, or to pay military fines, subjects them to legal restraint on their goods, and if none of these be found, to imprisonment. Tithes and other ecclesiastical claims, enforced upon them, likewise render restraint a very common, and sometimes an oppressive occurrence: and if the prosecutor be more rigorous, they may be imprisoned for an indefinite time. In America they are exempt from ecclesiastical but not from military seizures; by which, during the war for independence, many of them were impoverished. It is obvious that, refusing to swear, they cannot fill any office of profit or trust under government. Except for these purposes however, for serving on juries, and in cases of criminal prosecution, their solemn affirmation before the magistrate has the legal force of an oath.

The Quakers are dispersed over the united kingdom, and most of the states of North America; from the southern states of the latter they have mostly emigrated of late to the Ohio. In America they are chiefly engaged in agriculture; and for a series of years have been making judicious and successful efforts to introduce this, with the other arts, and the manners of civilized life, among the Indian natives. There are a few Quakers in Germany, and their principles are entertained by some persons in France.

In this country they are found chiefly in the middle class of citizens, and in trade or manufacture. Their general dereliction of agriculture seems to have resulted from the impediments offered by the tithing system: a yoke which, under their scruple, becomes doubly heavy on the farmer. There is a greater approach to equality in the civil condition of the Quakers, than obtains in almost any other body: the children of such as become very rich are apt to quit the society, either by marrying persons not in its communion, or for the sake of liberties which it prohibits: and the children of the poor commonly get a plain but solid education, superior to their condition, by means of which they rise in civil society to a higher level. They have several excellent establishments for this purpose: the principal of which, situated at Ackworth in Yorkshire, contains, of both sexes, three hundred children, and was founded in 1778, at the instance of Dr. Fothergill. With provision for mathematical and classical learning, the Quakers, though they have some good private schools, are but slenderly furnished; and they have in consequence few accomplished men in these branches. They are by no means deficient in general information, and of late years many of them have cultivated natural philosophy with success. The society in its earlier stage, including many men of regular scholastic education, who had joined it on principle, had of course the advantage, in point of theological knowledge, over the modern Friends, who chiefly inherit their profession, and whose education has but of late begun to include systematic instruction in the doctrines of Christianity at large.

In morals they are allowed to excel: their youth is watched over in this respect with more than ordinary care; and when grown up, their discipline prohibits, to all conditions, those amusements which offer to the mind the ready means of dissipating serious impressions. Habitual offenders against their peculiar regulations forfeit their membership, as well as those who violate the more obvious rules of justice and morality: their moral character, and consistency as a body, are thus kept up. But it is alleged, that they are not equally well guarded against a money-getting spirit; which is apt to grow upon those who intently prosecute trade and commerce to the exclusion of all other pursuits. From the occasional tenor of the society's advices to its members, it should seem that this is in a certain degree true; and that it

behoves them to seek for an adequate remedy. They are not, however, chargeable with the love of money for its own sake; no class of men being more beneficent, or more prompt to contribute their time and substance to various public institutions, which the spirit of the Christian religion has at length raised up, for relieving the distresses, promoting the comforts, and improving the moral and religious condition of mankind.

As to the minuter features of their character, the Quakers are prudent and methodical in their business; generally good economists of time and money. Their conversation has many peculiarities; some of which flow from their principles, others merely from their associating chiefly among themselves. They were early thought to be habitually crafty ("the Quaker sly," says Pope); but there seems no other ground for this, than the extreme caution with which they incur engagements, or make professions and promises. Viewed at a distance, they appear cold, formal, and reserved in their manners; and have hence been unjustly concluded void of domestic cheerfulness, and incapable of the enjoyments arising from social converse, and the intercourse of cultivated minds. They are plain in their dress; the peculiarities observable in which result, not from any regulations on the subject, but from an indisposition to vary with the fashion; they have, however, slowly followed changes which have proved general and permanent, and thus become less conspicuously singular. Mourning habits they reject on principle: and with a people whose ordinary dress is so grave, the moral reason for them seems not to exist. They are averse to splendour in furniture and equipage: though the rich among them, in these articles, and most of their females in dress, have contrived, without ceasing to be known as Quakers, to refine considerably upon absolute simplicity.

Doctrine.—A recent publication on behalf of the society, entitled, "A Summary of the History, Doctrine, and Discipline of Friends," ascribed to one of the society, held in high estimation, viz. Mr. J. G. Bevan, who died whilst this article was in the press, states their doctrine as follows:

"We agree with other professors of the Christian name, in the belief of one eternal God, the creator and preserver of the universe; and in Jesus Christ his Son, the Messiah, and mediator of the new covenant.

"When we speak of the gracious display of the love of God to mankind, in the miraculous conception, birth, life, miracles, death, resurrection, and ascension of our Saviour, we prefer the use of such terms as we find in scripture; and contented with that knowledge, which divine wisdom hath seen meet to reveal, we attempt not to explain those mysteries which remain under the veil; nevertheless we acknowledge and assert the divinity of Christ, who is the wisdom and power of God unto salvation.

"To Christ alone we give the title of the Word of God, and not to the scriptures; although we highly esteem these sacred writings, in subordination to the Spirit from which they were given forth; and we hold with the apostle Paul, that they are able to make wise unto salvation, through faith which is in Christ Jesus.

"We revere those most excellent precepts, which are recorded in scripture to have been delivered by our great Lord, and we firmly believe that they are practicable and binding on every Christian; and that in the life to come every man will be rewarded according to his works. And further it is our belief, that, in order to enable mankind to put in practice these sacred precepts, many of which are contradictory to the unregenerate will of man, every man coming into the world, is endued with a measure of the

light, grace, or good Spirit of Christ; by which, as it is attended to, he is enabled to distinguish good from evil, and to correct the disorderly passions and corrupt propensities of his fallen nature, which mere reason is altogether insufficient to overcome. For all that belongs to man is fallible, and within the reach of temptation; but this divine grace, which comes by Him, who hath overcome the world, is, to those who humbly and sincerely seek it, an all-sufficient and present help in time of need. By this, the snares of the enemy are detected, his allurements avoided, and deliverance is experienced through faith in its effectual operation: whereby the soul is translated out of the kingdom of darkness, and from under the power of Satan, into the marvellous light and kingdom of the Son of God.

"Being thus persuaded that man, without the spirit of Christ inwardly revealed, can do nothing to the glory of God, or to effect his own salvation; we think this influence especially necessary to the performance of the highest act of which the human mind is capable; even the worship of the Father of lights and of spirits, in spirit and in truth: therefore we consider as obstructions to pure worship, all forms which divert the attention of the mind from the secret influence of this unction from the Holy One. Yet, although true worship is not confined to time and place, we think it incumbent on Christians to meet often together, in testimony of their dependence on the heavenly Father, and for a renewal of their spiritual strength: thus, 'Each not only partakes of the particular refreshment and strength which comes from the good in himself, but is a sharer of the whole body, as being a living member of the body, having a joint fellowship and communion with all.' Barclay.

"Nevertheless, in the performance of worship, we dare not depend, for our acceptance, on a formal repetition of the words and experiences of others; but we believe it to be our duty to lay aside the activity of the imagination, and to wait in silence to have a true sight of our condition bestowed upon us; believing even a single sigh, arising from such a sense of our infirmities, and of the need we have of divine help, to be more acceptable to God, than any performances, however specious, which originate in the will of man. If any should object the difficulty of laying aside the activity of the imagination, let such consider the following statement—That it is our duty to maintain a watch over our thoughts, by endeavouring to preserve our attention from being carried away by such as manifestly originate in our own natural will or habits, and to wait patiently for the arising of the life of Christ; which by bringing every thought into subjection, produces a true inward silence, and therein affords a true sense of our condition.

"From what has been said respecting worship, it follows that the ministry we approve must have its origin from the same source; for that which is needful for a man's own direction, and for his acceptance with God, must be eminently so to enable him to be helpful to others. Accordingly we believe, that the renewed assistance of the light and power of Christ is indispensably necessary for all true ministry; and that this holy influence is not at our command, or to be procured by study, but is the free gift of God to chosen and devoted servants.—Hence arises our testimony against preaching for hire, in contradiction to Christ's positive command, 'Freely ye have received, freely give;' and hence our conscientious refusal to support such ministry, by tithes or other means.

"As we dare not encourage any ministry, but that which we believe to spring from the influence of the Holy Spirit, so neither dare we attempt to restrain this ministry to persons of any condition in life, or to the male sex alone; but,

as male and female are one in Christ, we hold it proper that such of the female sex as we believe to be endued with a right qualification for the ministry, should exercise their gifts for the general edification of the church; and this liberty we esteem a peculiar mark of the gospel dispensation, as foretold by the prophet Joel, and noticed by the apostle Peter.

"Three are two ceremonies in use among most professors of the Christian name, water-baptism, and what is termed the Lord's supper. The first of these is generally esteemed the essential means of initiation into the church of Christ; and the latter, of maintaining communion with him. But as we have been convinced that nothing short of his redeeming power, inwardly revealed, can set the soul free from the thralldom of sin; by this power alone we believe salvation to be effected. We hold that as there is one Lord and one faith, so his baptism is one, in nature and operation; that nothing short of it can make us living members of his mystical body; and that the baptism with water, administered by his fore-runner John, belonged, as the latter confessed, to an inferior and decreasing dispensation.

"With respect to the other rite, we believe that communion between Christ and his church is not maintained by that, or by any other external performance, but only by a real participation of his divine nature through faith; that this is the supper alluded to in the Revelation, 'Behold I stand at the door and knock: if any man hear my voice, and open the door, I will come in to him, and will sup with him, and he with me,' and that where the substance is attained, it is unnecessary to attend to the shadow: which doth not confer grace, and concerning which, opinions so different, and animosities so violent, have arisen.

"Now, as we thus believe that the grace of God, which comes by Jesus Christ, is alone sufficient for salvation, we can neither admit that it is conferred on a few only, whilst others are left without it; nor, thus asserting its universality, can we limit its operation to a partial cleansing of the soul from sin, even in this life. We entertain worthier notions both of the power and goodness of our heavenly Father, and believe that he doth vouchsafe to assist the obedient to experience a total surrender of the natural will, to the guidance of his pure unerring Spirit; through whose renewed assistance they are enabled to bring forth fruits unto holiness, and to stand perfect in their present rank.

"There are not many of our tenets more generally known than our testimony against oaths, and against war. With respect to the former of these, we abide literally by Christ's positive injunction, delivered in his sermon on the mount, 'Swear not at all.' From the same sacred collection of the most excellent precepts of moral and religious duty, from the example of our Lord himself, and from the correspondent convictions of his Spirit in our hearts, we are confirmed in the belief that wars and fightings are, in their origin and effects, utterly repugnant to the gospel; which still breathes peace and good-will to men. We also are clearly of the judgment, that if the benevolence of the gospel were generally prevalent in the minds of men, it would effectually prevent them from oppressing, much more from enslaving, their brethren (of whatever colour or complexion), for whom, as for themselves, Christ died; and would even influence their conduct in their treatment of the brute creation, which would no longer groan, the victims of their avarice, or of their false ideas of pleasure.

"Some of our tenets have in former times, as hath been shewn, subjected our Friends to much suffering from government, though to the salutary purposes of government, our principles are a security. They inculcate submission to the laws, in all cases wherein conscience is not violated. But

we hold, that as Christ's kingdom is not of this world, it is not the business of the civil magistrate to interfere in matters of religion, but to maintain the external peace and good order of the community. We therefore think persecution, even in the smallest degree, unwarrantable. We are careful in requiring our members not to be concerned in illicit trade, nor in any manner to defraud the revenue.

"It is well known that the society, from its first appearance, has disused those names of the months and days, which having been given in honour of the heroes or false gods of the heathen, originated in their flattery or superstition; and also the custom of speaking to a single person in the plural number, as having likewise arisen from motives of adulation. Compliments, superfluity of apparel, of furniture, and of provision for the table, outward shows of rejoicing and mourning, and the observation of days and times, we esteem to be incompatible with the simplicity of a Christian life; and public diversions, gaming, and other vain amusements of the world, we cannot but condemn. They are a waste of that time which is given us for nobler purposes; and divert the attention of the mind from the sober duties of life, and from the reproofs of instruction, by which we are guided to an everlasting inheritance.

"To conclude, although we have exhibited the several tenets which distinguish our religious society, as objects of our belief; yet we are sensible that a true and living faith is not produced in the mind of man by his own effort; but is the free gift of God in Christ Jesus, nourished and increased by the progressive operation of his Spirit in our hearts, and our proportionate obedience. Therefore, although for the preservation of the testimonies given us to bear, and for the peace and good order of the society, we deem it necessary that those who are admitted into membership with us, should be previously convinced of those doctrines which we esteem essential; yet we require no formal subscription to any articles, either as a condition of membership, or a qualification for the service of the church. We prefer judging of men by their fruits, and depending on the aid of Him, who, by his prophet, hath promised to be 'for a spirit of judgment to him that sitteth in judgment.' Without this, there is a danger of receiving numbers into outward communion, without any addition to that spiritual sheep-fold, whereof our blessed Lord declared himself to be both the door and the shepherd; that is, such as know his voice, and follow him in the paths of obedience."

To this statement may be added the following extracts, the first of which is from a declaration issued on behalf of the society in 1693.

"We sincerely profess faith in God by his only-begotten Son Jesus Christ, as being our light and life, our only way to the Father, and also our only Mediator and Advocate with the Father;—that God created all things, he made the worlds, by his Son Jesus Christ, he being that powerful and living Word of God by whom all things were made; and that the Father, the Word, and the Holy Spirit, are One, in divine Being inseparable; One true, living, and eternal God blessed for ever;—yet that this Word or Son of God, in the fulness of time, took flesh, became perfect Man, according to the flesh descended and came of the seed of Abraham and David, but was miraculously conceived by the Holy Ghost, and born of the Virgin Mary, and also, farther, declared powerfully to be the Son of God, according to the Spirit of sanctification, by the resurrection from the dead;—that, as Man, Christ died for our sins, rose again, and was received up into glory in the heavens; he having, in his dying for all, been that one, great, universal offering and sacrifice for peace, atonement, and reconciliation between God and man; and he is the propitiation

tion not for our sins only, but for the sins of the whole world; we were reconciled by his death, but saved by his life;—that divine honour and worship is due to the Son of God; and that he is in true faith to be prayed unto, and the name of the Lord Jesus Christ called upon, (as the primitive Christians did,) because of the glorious union or oneness of the Father and the Son." Sewel's History, p. 643.

"The doctrine of the resurrection of the dead is so connected with the Christian religion, that it will be also proper to say something on this subject. In explaining our belief of this doctrine, we refer to the 15th chapter of the 1st Epistle to the Corinthians. In this chapter (verses 40. 42. 44. 50.) is clearly laid down the resurrection of a body, though not of the same body that dies. Here we rest our belief in this 'mystery,' without desiring to pry into it beyond what is revealed to us; remembering that 'secret things belong unto the Lord our God, but those things which are revealed belong unto us and to our children.' Principles of Religion, as professed by the Quakers, by Henry Tuke.

Discipline: from the "Summary," with some abridgment.—"The purposes which our discipline hath chiefly in view, are, the relief of the poor, the maintenance of good order, the support of the testimonies which we believe it is our duty to bear to the world, and the help and recovery of such as are overtaken in faults: in a few words, the promotion of piety and charity.

"In the practice of discipline, we think it indispensable that the order recommended by Christ himself be invariably observed. 'If thy brother shall trespass against thee, go and tell him his fault between thee and him alone: if he shall hear thee, thou hast gained thy brother; but if he will not hear thee, then take with thee one or two more, that in the mouth of two or three witnesses, every word may be established; and if he shall neglect to hear them, tell it unto the church.'

"To effect the salutary purposes of discipline, meetings were appointed, at an early period of the society, which, from the times of their being held, were called quarterly meetings. It was afterwards found expedient to divide the districts of those meetings, and to meet more frequently: from whence arose monthly meetings, subordinate to those held quarterly. At length, in 1669, a Yearly Meeting was established, to superintend, assist, and provide rules for, the whole: previously to which, general meetings had been occasionally held.

"A monthly meeting is usually composed of several particular congregations, situated within a convenient distance from each other. Its business is to provide for the subsistence of the poor, and for the education of their offspring; to judge of the sincerity and fitness of persons appearing to be convinced of the religious principles of the society, and desiring to be admitted into membership; to excite due attention to the discharge of religious and moral duty; and to deal with disorderly members. Monthly meetings also grant to such of their members as remove into other monthly meetings, certificates of their membership and conduct; without which they cannot gain membership in such meetings. Each monthly meeting is required to appoint certain persons, under the name of overseers, who are to take care that the rules of our discipline be put in practice; and when any case of complaint, or disorderly conduct, comes to their knowledge, to see that private admonition, agreeably to the gospel rule before mentioned, be given, previously to its being laid before the monthly meeting.

"When a case is introduced, it is usual for a small committee to be appointed, to visit the offender, to endeavour

to convince him of his error, and to induce him to forsake and condemn it. If they succeed, the person is by minute declared to have made satisfaction for the offence; if not, he is disowned as a member of the society.

"In disputes between individuals, it has long been the decided judgment of the society, that its members should not sue each other at law. It therefore enjoins all to end their differences by speedy and impartial arbitration, agreeably to rules laid down. If any refuse to adopt this mode, or, having adopted it, to submit to the award, it is the direction of the yearly meeting that such be disowned.

"To monthly meetings also belongs the allowing of marriages; for our society hath always scrupled to acknowledge the exclusive authority of the priests in the solemnization of marriage. Those who intend to marry, appear together, and propose their intention to the monthly meeting; and if not attended by their parents or guardians, produce a written certificate of their consent, signed in the presence of witnesses. The meeting then appoints a committee to inquire whether they be clear of other engagements respecting marriage; and if, at a subsequent meeting, no objections be reported, they have the meeting's consent to solemnize their intended marriage. This is done in a public meeting for worship, towards the close whereof the parties stand up, and solemnly take each other for husband and wife. A certificate of the proceedings is then publicly read, and signed by the parties, and afterwards by the relations, and others as witnesses. Of such marriages the monthly meeting keeps a record: as also of the births and burials of its members. A certificate of the date, of the name of the infant, and of its parents, signed by those present at the birth, is the subject of one of these last mentioned records; and an order for the interment, countersigned by the grave-maker, of the other. The naming of children is without ceremony. Burials are also conducted in a simple manner. The body, followed by the relations and friends, is sometimes, previously to interment, carried to a meeting; and at the grave a pause is generally made; on both which occasions it frequently falls out, that one or more friends present have somewhat to express for the edification of those who attend; but no religious rite is considered as an essential part of burial.

"Several monthly meetings compose a quarterly meeting. At the quarterly meeting are produced written answers from the monthly meetings, to certain queries respecting the conduct of their members, and the meeting's care over them. The accounts thus received, are digested into one, which is sent, also in the form of answers to queries, by representatives, to the yearly meeting. Appeals from the judgment of monthly meetings are brought to the quarterly meetings; whose business also it is to assist in any difficult case, or where remissness appears in the care of the monthly meetings over the individuals who compose them.

"The yearly meeting has the general superintendence of the society in the country in which it is established: and therefore, as the accounts which it receives discover the state of inferior meetings, as particular exigencies require, or as the meeting is impressed with a sense of duty, it gives forth its advice, makes such regulations as appear to be requisite, or excites to the observance of those already made; and sometimes appoints committees to visit those quarterly meetings which appear to be in need of immediate advice. Appeals from the judgment of quarterly meetings are here finally determined, and a brotherly correspondence, by epistles, is maintained with other yearly meetings.

"There are eight yearly meetings, viz. 1. London, to which come representatives from Ireland; 2. New England; 3. New York; 4. Pennsylvania and New Jersey; 5. Maryland; 6. Virginia; 7. The Carolinas and Georgia; 8. Ohio.

"In

"In this place it is proper to add, that, as we believe women may be rightly called to the work of the ministry, we also think that to them belongs a share in the support of our Christian discipline; and that some parts of it wherein their own sex is concerned, devolve on them with peculiar propriety. Accordingly they have monthly, quarterly, and yearly meetings of their own sex, held at the same time with those of the men; but separately, and without the power of making rules.

"In order that those who are in the situation of ministers may have the tender sympathy and counsel of those of either sex, who, by their experience in the work of religion, are qualified for that service, the monthly meetings are advised to select such, under the denomination of elders. These, and ministers approved by their monthly meetings, have meetings peculiar to themselves, called meetings of ministers and elders; in which they have an opportunity of exciting each other to a discharge of their several duties, and of extending advice to those who may appear to be weak, without any needless exposure. Such, it may be here observed, as believe themselves required to speak in meetings for worship, are not immediately acknowledged as ministers by their monthly meetings; but time is taken for judgment, that the meeting may be satisfied of their call and qualification. It will also sometimes happen, that such as are not approved will obtrude themselves as ministers, to the grief of their brethren; but much forbearance is used towards these, before the disapprobation of the meeting is publicly testified. These meetings of ministers and elders are generally held in the compass of each monthly, quarterly, and yearly meeting. They are conducted by rules prescribed by the yearly meeting, and have no authority to make any alteration or addition to them. The members of them unite with their brethren in the meetings for discipline, and are equally accountable to the latter for their conduct.

"It is to a meeting of this kind in London, called the second-day's morning meeting, that the revival of manuscripts concerning our principles, previously to publication, is intrusted by the yearly meeting held in London: and also the granting, in the intervals of the yearly meeting, of certificates of approbation to such ministers as are concerned to travel in the work of the ministry in foreign parts; in addition to those granted by their monthly and quarterly meetings.

"The yearly meeting of London, in the year 1675, appointed a meeting to be held in that city, for the purpose of advising and assisting in cases of suffering for conscience-sake, which hath continued with great use to the society to this day. It is composed of friends under the name of correspondents, chosen by the several quarterly meetings, and who reside in or near the city. The same meetings also appoint members of their own in the country as correspondents, who are to join their brethren in London on emergency. The names of all these correspondents, previously to their being recorded, are submitted to the approbation of the yearly meeting. Such men as are approved ministers are also members of this meeting, which is called the Meeting for Sufferings; a name arising from its original purpose, and which is not yet become entirely obsolete.

"The yearly meeting has intrusted the meeting for sufferings with the care of printing and distributing books, and with the management of its stock; and, considered as a standing committee of the yearly meeting, it hath a general care of whatever may arise, during the intervals of that meeting, affecting the society, and requiring immediate attention: particularly of those circumstances which may occasion an application to government. The stock of the yearly meeting, just mentioned, is an occasional voluntary contribution, expended in printing books,—salary of a clerk for

keeping records,—the passage of ministers who visit their brethren beyond sea,—and some small incidental charges: but not, as has been falsely supposed, the reimbursement of those who suffer restraint for tithes and other demands with which they scruple to comply." G. Fox's Journal. Sewel's History of the Quakers. Gough's History of the Quakers. Bessie's Sufferings of the Quakers. Barclay's Apology. Clarkson's Portraiture of Quakerism.

The editor is indebted for the historical part of the preceding article to a respectable member of the society of Friends. Mr. Clarkson's work, which was composed in consequence of his intimate personal acquaintance with many of its leading members, produced by his labours for the abolition of the slave trade, may be consulted for a more ample account of the manners, practices, and opinions of this society.

QUAKER-TOWN, in *Geography*, a post-town of America, in Bucks county, Pennsylvania; 184 miles from Washington.

QUAKING-BOG, in *Agriculture*, a name usually given to a sort of soft pulpy, flexible, earthy depositions, which are formed in hollow moist situations, in consequence of the stagnation of water in them in some manner or other. Bogs of this kind differ much in their nature, qualities, and properties, according to the difference of circumstances and situations, but they have all a tremulous motion under the foot, when capable of being trodden upon. See BOG and QUAGMIRE.

Draining is here equally necessary, as in all other cases of a similar kind, and may mostly be carried into execution without any great difficulty.

QUAKING-GRASS, in *Botany*, so called from the trembling of the little pendulous spikelets, occasioned by their capillary zigzag stalks. See BRIZA.

QUAKING-GRASS, in *Agriculture*, the common name of a sort of grass, which is said to thrive and flourish well on moist kinds of poor cold land, and which cattle eat in a greedy manner; but which is not much adopted for cultivation in grass grounds, though it makes tolerably good hay. See BRIZA.

QUAKU, or QUAQUA, in *Geography*, a district of Africa, on the Gold Coast.

QUALATCHE, a town of the state of Georgia; 40 miles W.N.W. of Tuglooc.

QUALE JUS, in *Law*, was an ancient writ judicial, which lay where a religious person had judgment to recover land; before execution was made of the judgment.

This writ was issued forth to the escheator between judgment and execution, to enquire whether the religious person had right to recover, or whether the judgment were obtained by collusion between the demandant and tenant; to the intent that the true lord might not be defrauded.

QUALEA, in *Botany*, a Caribbean name, used by Aublet, and inadvertently adopted by Schreber; possibly because, as it appears, he suspected the genus not to be sufficiently distinct from *Vochy* of the same author, his own *CUCULARIA*; see that article. Willdenow, however, has followed him; and thus one name more is added to dunghill, which some future botanical Hercules must sweep away.—Aubl. Guian. v. 1. 5. Schreb. 7. Willd. Sp. Pl. v. 1. 18. Mart. Mill. Dict. v. 4. Juss. 424. Lamareck Illustr. t. 4.—Clas and order, *Monandria Monogynia*. Nat. Ord. perhaps *Guttifera*, Juss.

Gen. Ch. Cal. Perianth inferior, of one leaf, in four very deep ovate, coriaceous, concave, unequal segments; the two lowermost largest, spreading widely. Cor. Petals two, unequal, inserted into the calyx; the uppermost erect, roundish, emarginate, terminating at the base behind, in a short, obtuse, horn-like nectary, projecting between the upper segments

ments of the calyx; lowermost largest, sloping downward. *Stam.* Filament solitary, short, ascending, inserted betwixt the lower petal and the germen; anther oblong, furrowed, recurved. *Pist.* Germen superior, globose; style thread-shaped, ascending, the length of the stamen; stigma obtuse. *Peric.* Berry? of one cell. *Seeds* numerous, imbedded in pulp.

Obf. The corolla is, as it were, two-lipped. This genus is akin to *Cucullaria*. *Schreb.*

Ess. Ch. Calyx inferior, in four deep unequal segments. Petals two, unequal. Berry? with many seeds.

1. *Q. rosea*. Aubl. Guian. t. 1. Willd. n. 1.—Lower petal undivided. Leaves elongated at the point.—Native of the woods of Guiana, flowering in September. The inhabitants call this species *Laba-laba*. A tree, whose trunk is sixty feet or more in height, terminating in large spreading branches. Wood red, compact. Leaves opposite, in pairs crossing each other, on shortish stalks, elliptical, three or four inches long, entire, smooth, with an elongated blunt point; their transverse veins very numerous, straight and parallel. *Stipulas* deciduous. *Panicles* terminal. *Flowers* numerous, two inches long, powerfully and agreeably scented, white on the outside, rose-coloured, and finally yellowish, within.

2. *Q. carulea*. Aubl. Guian. t. 2. Willd. n. 2.—Petals two-lobed. Leaves with a short point.—Native of the Guiana forests. This species flowers in October, and is known by the name of *Qualé*. It differs from the former in having smaller flowers, of a grey or blueish colour, but fragrant like those of *Q. rosea*. Their petals are emarginate, or almost obcordate. Points of the leaves less elongated.

QUALIFICATION for killing game, for jurors, justices, members of parliament, and electors of members. See GAME, JURY, JUSTICES, and PARLIAMENT.

QUALIFICATIONS for a complete musician, required by Zarlino. This venerable theorist had very exalted ideas of a perfect musician, and tells us (*Instit.* vol. ii. part iv. p. 342, et seq.) that it is necessary he should have a knowledge in arithmetic, for the calculation of musical proportions; of geometry, to measure them; of the monochord and harpichord, to try experiments and effects; that he should be able to tune instruments, in order to accustom the ear to distinguish and judge of intervals; that he should sing with truth and taste, and perfectly understand counterpoint; that he should be a grammarian, in order to write correctly, and set words with propriety; that he should read history, to know the progress of his art; be a master of logic, to reason upon, and investigate the more abstruse parts of it; and of rhetoric, to express his thoughts with precision; and, further, that he would do well to add to these sciences some acquaintance with natural philosophy, and the philosophy of sound; that his ears being perfectly exercised and purified, may not be easily deceived. And adds, that he who aspires at the title of perfect musician, has occasion for all these qualifications, as a deficiency in any one of them will frequently render the rest useless. An additional qualification is now become necessary to be added to those enumerated by Zarlino, which is a perfect knowledge of the genius and powers of all the instruments for which a musician writes; otherwise he will not only embarrass a performer by useless and unmeaning difficulties, but lose opportunities of producing effects by the bow of a violin, the *coup de langue* of flutes, and a selection of the purest and best tones on other wind instruments.

QUALIFICATIONS of Land-managers, &c. the requisite acquirements which are proper and essential to them in order to the due and full performance of all the different sorts of business in which they may be engaged or employed. In this view, a considerable knowledge of the principles and practices of different sorts of farming and farm-management,

some acquaintance and experience in surveying land, in mechanics, in rural architecture, and in the business of planting, are indispensably necessary, as well as a notion of the various mineral and other substances contained in the bowels of the earth, and a ready facility in arranging the management of different sorts of accounts.

They should at the same time possess mild, conciliatory dispositions, exact upright principles, and strict moral characters. See *LAND-Reeve*, *LAND-Steward*, and *OFFICE of Estate*.

The duties and uses of these sorts of managers, besides those of regulating and directing the husbandry, management, and other matters, are, the preventing all sorts of encroachments from taking place; the seeing that a proper and right method of stocking is pursued on the commonable lands; the guarding against the turf or soil being injured by being broken up or pared off; the looking after the public and private roads, lanes, and driftways, to see that the fences on the sides of them are properly cut and pruned as occasion may require, the travelling parts of them kept free from obstructions, and in a suitable state of repair, and that the farm-ways are well calculated to the uses and intentions for which they were designed; the duly attending to the open drains, water courses, and common sewers, to take care that they are kept clear and free at all times, without doing injury to any one; the considering the state of the natural streams and running waters as fit for the purposes of watering live-stock at home or in other places, those of irrigating land, the turning of mills, &c.; the examining the borders of rivers, brooks, &c. to see that they are not carried away, or their courses altered in any injurious manner: the taking care of plantations, and all sorts of woodlands, as well as timber-trees and young plants, by seeing that they are preserved in a proper manner, and no damages committed by cutting them down, or in any other ways; the attending to the situation of the fences, gateways, &c. to see that the live hedges, with their banks, be duly cut, weeded, pruned, and kept up, as well as the gates, stiles, pales, and other dead fences properly preserved and in repair; the keeping the home buildings, farm cottages, and garden grounds, belonging to them, in proper condition, with their tenants in a full state of industry; and lastly, the regulating the order of the different occupiers, by preventing improper meetings of all kinds, the repressing of bad houses, and all sorts of irregularities that have a tendency to lessen industry and frugality.

Besides these, there are many other duties which properly belong to them, but which need not be mentioned in this place. See *BAILIFF*.

QUALIFICATIONS of Tenants, the necessary properties and circumstances which render them fit for holding lands as farms. The importance of having persons perfectly qualified as tenants, is very great, in the superintendence and management of all landed property, being, in a great measure, the basis, or principal bearing, on which its uniform and lasting prosperity depends.

The proper qualifications of a good tenant, according to the author of the "*Treatise on Landed Property*," are the having capital, skill, industry, and character. And he contends, that without a sufficient capital, the rest are unavailing; but that, at the same time, an industrious, frugal, good farmer will strive with difficulties, and get on with less money than a man of contrary qualifications. But if he has not sufficient strength to work his lands, nor a sufficiency of live-stock to raise manure, or money wherewith to purchase it, he must, under ordinary circumstances, live in a state of poverty and hard labour; and, on the first attack of misfortunes, or the first failing season of crops, he will probably sink

sink under the weight of his accumulated burden, and be ruined.

Further, that in regard to the proper ratio or proportion between the rent and capital, it depends on the existing state and circumstances of the farms, and the style of management in which they are intended to be conducted; as well as on the number and strength of the occupiers' families, and their industry and frugality. However, in order to afford some general notions on the matter, it may be said that, for farms of size, as those of from one to five hundred pounds a year, the occupiers should have at their commands from five hundred to a thousand pounds of capital, for every hundred pounds of rent which they may pay. Yet still, on the greater number of farms, the first proportion is too small to manage them with full advantage and profit. And, if they be farmed with spirit, and the higher order of improvements be attempted, particularly the introduction of the best breeds of live-stock adopted by modern farmers, the last will not be found too large for the purpose.

It may be remarked, that it is constantly the best way for tenants to farm somewhat within their capitals, as a few pounds kept in their pockets enables them to embrace and take the advantage of every favourable opportunity that may offer, and to sell or buy with the greatest benefit. While such as are straitened for money, are forced to take the chance of markets, and liable to make bargains of a losing and disadvantageous nature, as well as experience many other inconveniences of different kinds.

Notwithstanding, where there is a want of sufficient experience and skill in the art, and different branches of practical husbandry, tenants cannot farm or manage their lands with the most profit, either to themselves, or the proprietors of them. Where, however, their capitals and exertions are great, they may, by observation and practice, acquire skill; and by this means be enabled to perform the business in a tolerable manner, and in some measure do justice to their farms, whatever they may do for their families in the way of getting money for their benefit. But where, with a want of skill, scanty capitals are joined, it is not all the exertion, industry, and frugality in the power of man, that can save or preserve the families or the farms from injury and inconvenience.

However, without industry, capital and skill may be said to be thrown away. In the management of rural business, in which so much depends on the nature of seasons and weather, idleness is a vice of the darkest cast. Every instance of negligence is not only injurious in itself, but operates as a dangerous and bad example; serving as an apology or excuse for the half industrious, with whom every farm or estate is incumbered in a greater or less degree.

In consequence of the intimate connection which necessarily subsists between the proprietors and the occupiers of land, and seeing how advantageous and profitable it is to preserve good order and regularity upon farm lands, as giving thereby full liberty and freedom to the exertions of their tenantry, it becomes a matter of some importance, in the selection of farm-tenants, to make proper and necessary inquiries into their characters for morality, and particularly as they relate to habits of sobriety or extravagance, as well as to a peacefulness or quarrellousness of disposition.

And it is farther to be remarked, in respect to the proper selecting of tenants for farms, that nothing of interest, or any other consideration whatever, that is not intimately connected with the above qualifications, can properly warrant the choice: unless in particular cases and circumstances, as in providing for the widows and orphans of deceased

tenants, &c. A farm-manager should not suffer himself to be influenced by any sort of family connection, favour, fee, or reward. Superintendants of this kind, merely as such, cannot have any true interests separate and distinct from those of the farms or lands they may overlook. It, therefore, becomes a dishonest act in any agent of this sort, to put an inferior tenant into the possession of a farm, through his own interest, even at a fair rent for the same.

Lastly, it may be noticed, that in a district which stands forward in a prominent manner in the ranks of rural improvements, merit should be looked for and encouraged near home. But to advance or bring up a farm or estate which remains in the rear of modern practices, two or more tenants of the higher classes should be sought for, at a distance, in such districts as are of a kindred nature, but in which the more modern and profitable management of farming prevails, in order to lead and direct the native tenantry of the situation.

These are some of the principal and leading qualifications which ought in all cases to direct and regulate the choice of farm-tenants; there are, however, many others which should have an influence in certain circumstances, and particular methods of farm-management, otherwise the full interests and advantages of the proprietors of the lands may be overlooked and neglected.

QUALIFICATOR, in the *Canon Law*, a divine appointed to qualify, or declare the quality of, a proposition brought before an ecclesiastical tribunal; chiefly before the inquisition.

The qualificators of the office are not judges; they only give their sentiments on the propositions presented to them. They are the inquisitors that judge.

QUALITY, *QUALITAS*, that affection of a thing, whence it is denominated such; or that which occasions a thing to affect our senses in this or that manner, and gives it this or that denomination. Accordingly quality is said to be an attribute, from which no substance is exempt. See **MODE**.

Thus, that power in fire, whatever it be, by which it excites in us the sensation of heat, since it is that whence the fire is denominated hot, is called the quality of fire.

The word quality, *qualitas*, is said to have been first introduced into the Latin by Cicero: till his time the Romans studiously avoided using a term which denoted an abstract; and in lieu of it only considered concrete, signified by *quale*. The like is observed of the ancient Greeks, who did not use *ποιότης*, but *ποιοῦν*.

Quality, it is to be observed, is an ambiguous term; and has been applied to some things which ought rather to have been looked upon as states of matter, or assemblages of several qualities; as life, health, beauty, &c.

There are, also, other attributes, as size, shape, motion, and rest, usually reckoned among qualities, which might more conveniently be ranked among the primary modes of the parts of matter; since, from these simple attributes, all the qualities are derived.

The ancient school-philosophers distinguish quality in the general, which they call *metaphysical* and *predicamental* quality, into *essential* and *accidental*. The moderns more usually divide it into *spiritual* and *corporeal*.

QUALITEIS, *Spiritual*, or *Qualities of the Soul*, are affections of the mind, considered as in this or that habitude or disposition. Of these they make two kinds; the one belonging to the understanding, the other to the will: of the former kind are knowledge, opinion, certainty, doubting, &c. Of the latter are all the moral virtues and vices.

QUALITIES, *Corporeal* or *Physical*, are what we chiefly consider under this denomination, and to which the definition above laid down is accommodated.

Philosophers are divided as to the nature of these qualities, or what they are in the body. The general language of the Peripatetic school is, that they are things distinct from the bodies themselves; and are superadded to them, or flow from their substantial forms: on which principle, they hold qualities to be real, and denominate them *accidents*; supposing them to be inherent in substances, though not in the relation of parts, but to be sustained by them as in a subject, and incapable of subsisting without them. In effect, the Thomists define qualities to be accidents following or arising from the form; in the same manner as quality is an accident following or arising from the substance.

The moderns absolutely explode the notion of qualities distinct from the body; and insist, that the powers by which bodies excite in us the ideas of such qualities, are no other than the mechanical affections of the bodies themselves, *viz.* the figure, magnitude, motion, &c. of the parts of which they consist.

The principal considerations insisted on by the retainers to real qualities are, that these powers may be actually separated from the substances they inhere in; as we see in light, heat, &c. That from these very qualities, considered as so many determinations, there arises a very great diversity in bodies; and that bodies, according to the diversity of their qualities, affect our senses very differently.

The adherents to the experimental way, on the contrary, account for all the qualities of bodies from mechanical causes. Thus all the phenomena of a clock, the motion of its wheels, its hands, &c. by which it strikes the hour, points the minute; day, moon's age, &c. do all evidently arise from the single spring; which we never imagine to have any particular powers by which it should be enabled to make such discoveries; nor any other principle but that one of elasticity. Why, then, may we not conceive, as to sensible qualities, that though, by virtue of a certain congruity or incongruity in point of figure, texture, or other mechanical properties, the portions of matter they modify are enabled to produce various effects, on account of which the bodies are said to be endowed with qualities; yet these are not, in the bodies endowed with them, any real or distinct entities, or differing from the matter itself of such a determinate bigness, shape, and other mechanical modifications? Thus, though the modern goldsmiths and refiners reckon it among the most distinguished qualities of gold that it is dissoluble in aqua regia, whilst aqua fortis will not work upon it; yet these attributes are not in the gold any thing distinct from its peculiar texture; nor is the gold we have now of any other nature than it was in Pliny's time, when aqua fortis and aqua regia were unknown.

We all know that the sun hath a power to harden clay, soften wax, melt butter, thaw ice, turn water into vapour, make air expand itself in weather-glasses, contribute to blanch linen, render the white skin of the face swarthy, and mowed grass yellow, ripen fruit, hatch the eggs of silk-worms, caterpillars, &c. and perform many other things, some of which seem contrary to others; yet these are not distinct powers, or faculties in the sun, but only the production of its heat, diversified by the different textures of the body it chances to work on, and the condition of the other substances concerned in the operation. And, therefore, whether or not the sun, in some cases, has any influence at all distinct from its light and heat, we see that all the phenomena mentioned are producible by the heat of common

fire, duly applied and regulated. Some of the ancients, and particularly the Peripatetics, have distinguished qualities into *sensible* and *occult*.

QUALITIES, *Sensible*, or *Manifest*, are those arising from certain modifications of matter, and which become immediately the objects of our senses. Such are all those above-mentioned.

Though, in strictness, those only are said to be sensible qualities which affect some one sense alone; as colour does the eye, sound the ear, &c.

These are sometimes, also, called *tangible* qualities, because they only produce their effect, *i. e.* excite their idea in us, when contiguous, or in contact with the organ.

QUALITIES, *Occult*, are certain latent powers arising from the specific forms of things, of which no rational solution can be given on any principles of physics.

Sensible qualities are usually subdivided into *primary* and *secondary*. See IDEAS.

QUALITIES, *Primary*, or *General*, are such as are found in all bodies; or which agree to all matter, considered as matter, and therefore to the elements themselves. Such are extension, figure, motion, rest, solidity, impenetrability, and number.

QUALITIES, *Secondary*, or *Particular*, are such as result from a composition or mixture of elements, and do not agree to body as body, but as a mixt. Such are light, heat, cold, colour, sound, taste, smell, hardness, softness, fluidity, firmness, roughness, smoothness, opacity, transparency, &c.

According to Aristotle, and the Peripatetics, the primary, or elementary qualities, are those of the four elements themselves; *viz.* heat, cold, moisture, and dryness.

The secondary qualities, according to the same, are all the rest; which are combinations or assemblages of the former elementary ones; as colour, odour, taste, &c.

To give an idea of Aristotle's method of accounting for these secondary qualities from these primary ones, we shall instance in his account of colour. All colours, then, says he, are generated of a mixture of the four elementary qualities: white, *e. gr.* is produced when the humidity surmounts the heat, as in old men, whose hair grows grey; black is produced when the humidity dries off, as in walls, cisterns, &c. red, &c.

Among the school-philosophers we meet with other divisions of qualities; as *active*, and *passive*; *real*, and *intentional*.

QUALITIES, *Active*, are those by virtue of which effects and operations are actually produced on other bodies duly disposed with respect to them. Such are the heat of fire, the moisture of water, &c.

QUALITIES, *Passive*, are those by which bodies are disposed to receive the action of others. Such are inflammability in oil, &c.

QUALITIES, *Real*, are those which remain in the subject, and only act on things adjacent to it. As fire in a piece of iron not ignited, &c.

QUALITIES, *Intentional*, are those which issue from the subject, and operate at a distance. Such is the light emitted from the sun, &c.

But the moderns are agreed, that either all qualities are real, or all alike intentional. So that the distinction is impertinent. See on the subject of quality, its various species, and its different properties, Harris's Philosophical Arrangements, chap. viii.

However ignorant we may be of the nature of qualities, or of the manner of their operation, yet we know the laws of their intention and remission. Dr. Keil demonstrates, that every quality which is propagated *in orbem*, such as light,

light, heat, cold, odour, &c. has its efficacy increased, or abated, in a duplicate ratio of the distances from the centre of radiation, or exertion of the quality, reciprocally.

Thus, let A (*Plate XII. Geometry, fig. 1.*) be a centre from whence any quality exerts itself round about, according to the right lines, A c, A f, &c. The efficacy of the quality, be it heat, cold, odour, &c. will be (at equal distances from A) as the spissitude or density of the rays, A b, A c, A d. But the rays within the inner circle, or rather spherical superficies, b c d I I, when they come to be extended to the other spherical surface, e f g K, will be much less close than they were before, and that in the reciprocal proportion of the spaces they take up; that is, if the outer surface be the double of the inner, the rays there will be but half as thick; but since spherical superficies are as the squares of their radii, therefore the efficacy of the quality in the inner surface will be to that of the outer, as A c square to A b square. Q. E. D.

Sir Isaac Newton lays it down as one of the rules of philosophizing, that those qualities of bodies which are incapable of being intended and remitted, and which are found to obtain in all bodies in which the experiment could ever be tried, are to be esteemed universal qualities of all bodies. See PHILOSOPHIZING.

QUALITIES, *Cosmical.* See COSMICAL Qualities.

QUALITY is also used for a kind of title, or degree of eminence given to certain persons, in regard of their territories, dignities, or other pretensions.

Thus the king of Great Britain used to take the quality of king of France; the king of Poland that of king of Sweden; the king of Sardinia that of king of Cyprus and Jerusalem; the czars of Russia, and kings of Spain, have whole pages of qualities. The emperor of China assumes the quality of son of the sun.

QUALITY of *Curvature*, in *Geometry*, is used to signify its form, as it is more or less inequable, or as it is varied more or less in its progress through different parts of the curve. Newton's *Meth. of Flux. and Inf. Ser.* p. 75. Maclaur. *Flux. art.* 369. See CURVATURE.

QUALITIES of *Trees and Plants*, in *Agriculture and Gardening*, are the properties which are peculiar to them, in relation to their magnitude, modes of growth, textures or consistences, forms, colours, tastes, smells, means of propagation, culture, uses, and values.

In regard to the first, as soon as the simple constituent fibres of plants are evolved and increased, as far as the nature of them and the arrangement of the primary nutrient substances will permit, they cease to receive any more for their farther increase; the primary matters merely replacing the loss which is occasioned by the performance of the natural functions of the plants; consequently they have each a particular prescribed increase or measure of growth. Some are very large, others extremely small. The Indian fig, in consequence of ramifications being sent off, which concrete with the primitive trunk, by insensible degrees acquires a very considerable bulk or thickness, being frequently twenty, or even thirty cubic feet in its diametric section. And there are accounts given of particular plants, which are scarcely visible to the naked eye; and of some trees, which are so large as to cover with their branches two hundred persons, or more.

In this country, some trees and shrubs of the ornamental sort are either very high, or very low: of the former kind are the horse-chestnut, larch, cornelian cherry, snowdrop-tree, and many others; and of the latter, the mountain-ash, hemlock, fir, Scotch rose, butchers' broom, and many more. There are some trees which are very broad, in pro-

portion to their height, as the oak, Spanish chestnut, &c.; others which are very narrow, as the larch, spruce fir, &c. And there are still some others, in which there is a medium between these extremes, preserved and kept up, as in the ash-leaved maple, the evergreen oak, the Virginian raspberry, the Guelder rose, and a number of others.

The modes or habits of growth in trees and shrubs are also extremely different: some sending out their branches in a horizontal manner, as in the oak; in others they have an upward direction, as in the Houghton willow; while in a few they fall downwards, as in the lime, acacia, and others. Again, there are some which have an oblique inclination, as may be seen in the Scotch fir; or they recline, and then rise up again, as in the larch kind; and there are still others, in which they hang directly downwards, as in the weeping ash, weeping willow, &c. There are likewise some shrubby plants, which creep along the surface of the ground, as the periwinkle; others which clasp themselves to trees, as the passion-flower; and a few which fix and attach themselves to buildings, walls, &c. as the ivy. Farther, there are some trees that, in whatever way they may be placed, cut, or pruned, constantly assume and take on one principal stem, from which all the different branches proceed or go off, as rays from a centre, as in the fir tribe; while in others, the trunks divide themselves into arms, or large branches, which send out boughs or smaller branches in an irregular manner, as in the oak and others. Some kinds of shrubs have merely one single stem, as the althæa; while other sorts invariably spread and extend along the surface of the ground, throwing or sending up a greater number, as the hypericum, and some others.

The texture or consistence of plants of different kinds is likewise very different, as hard, soft, membranous, carncous, smooth, downy, thorny, &c. which are mostly obvious to the feel. Plants of the young kind are commonly mucilaginous, becoming hard as they advance in growth; though many luxuriate in the state of continual softness, as the tremella; yet some are so hard as to sink in water, as the iron wood of the island of Ceylon, &c. Thus among trees and shrubs, some have a soft smooth appearance, as the lime, the scorpion fenna, &c.; while others have a hard, rough, firm appearance, as the evergreen oak, the holly, &c. There are some also which have a smooth, silky appearance, as the tamarisk, &c.; while others have a downy, woolly appearance, as the hoary poplar, &c. And some appear wholly beset and covered with thorns or prickles, as the furze, hedgehog holly, &c.; while others, again, appear wholly composed of thready shoots, as the Portugal broom, &c. Besides these, there are many other sorts, which furnish different appearances from any of these.

The forms in the different sorts and varieties are still equally, if not more, various; some being apparently solid and compact, from being thick set with branches and foliage, as in the horse-chestnut, the English elm, the lilac, the syringa, &c.; while others are of a more light, airy, elegant form, being thin of boughs, branches, and leaves, as the ash, the hoary poplar, the bird cherry, the Canadian mespilus, &c.; and there is a middle degree between these extremes, in the broad-leaved euonymus, the ash-leaved maple, and some others. They may also be further distinguished into those whose branches begin from nearly the surface of the ground, as in the fir tribe of trees, and most shrubs; and into those which shoot up into a stem before their branches are begun to be sent off, as in the mountain-ash, the althæa frutex, &c. It may likewise be noticed in respect to those whose branches begin from the ground, that some of them rise in an elegant cone, as the larch, the

holly, &c.; others in a cone, whose base is very broad, as in the cedar; or whose base is very small, as in the upright cypress. There are some which swell out in the middle of their growth, and diminish or contract at both ends, as in the Weymouth pine, &c.; while others are broadest at the top, as in the raspberry, the alpine honeysuckle, &c.; and some few irregular and bushy throughout, as in the evergreen oak, the snowball tree, &c. Among those which shoot up into a stem before their branches are sent off, there are some which are in the shape of slender cones, as in the deciduous cypress; others in those of broad cones, as in the balsam poplar. Still others assume a globular form, as in the mountain-ash; while many are irregular throughout, as in the Scotch elm, the acacia, and several others.

As to colour, it appears to depend upon the colouring principle, the proportion of vital air and light which is contained, and is proper to different parts of the same tree or plant; hence, when exhalation is prevented, and light intercepted, the green colour is changed into white. In trees and shrubs it is either accidental or permanent: the latter including all the different shades of green in the summer months; the former, the different tints of red and yellow, which are peculiar to the autumnal and vernal seasons.

There are some of the permanent kinds of colour, which are of a dark green, as those in the horse-chestnut, the yew, &c.; while others are of a light green, as those in the ash, the common laurel, &c.; and others, again, which are of a blueish-green, as those in the Scotch fir, the bladder senna, &c. Some trees have a green tinged with brown, as the Virginian cedar; others a green tinged with white, as the abele and the Lapland willow. Also, in some trees the greens are tinged with yellow, as in the ash-leaved maple, the Chinese arbor vitæ, &c.; in others with red, as in the scarlet maple, &c.; and in a few with purple, as in the purple beech. There are some greens which are spotted with white, yellow, and red, as that in the variegated holly, privet, fycamore, box, and various others. The colours which arise from accident are almost infinite in number, each kind of which is liable to great variation: mostly, however, it will be found that in autumn the wild cherry assumes a bright red, the birch a deep red, the beech a brownish-red, the scarlet oak a deep scarlet, the hornbeam a russet colour, the sugar maple a rich yellow, the common oak a reddish-yellow, the lime and ash a straw colour, the balsam poplar a black, the fycamore a dark brown, and others different sorts of other colours.

In regard to taste and smell, the former depends upon the different principles which compose and constitute the juices or humours of the different kinds, and varies as well in the different sorts, as in the different parts of the same sort of trees or plants. The latter depends on the volatile principle, or principles, which issue or exhale from them, and differs in its nature, according to the kinds of plants, or the parts of them, in which it chiefly resides or is present. There are some trees and shrubs which have scarcely any smell, as the evergreen oak, platanus, &c.; others have a most grateful rich fragrance, as the birch, sweet-briar, honeysuckle, &c.; some again have a luscious, powerful smell, as the mezereon, the tiringa, &c.; others a disagreeable nauseous smell, as the elder, &c.; in some the smell is very sweet, as in the flowering lime; in others it is deleterious, as in those of the walnut, the artemisia, &c. There is also the greatest fragrance in some while they are in blossom, as in the hawthorn, and in some it is solely confined to it, as in the lilac; while in others it is equally diffused over or throughout the whole plant, as in the sweet-briar, and many others.

These may be considered as some of the most general characteristic qualities of trees and shrubs; but various other peculiarities incident to them present themselves, on a more minute investigation, which equally interest and deserve the attention of the ornamental planter and gardener, as well as the cultivator of all sorts of wood and timber; and which principally relate to differences in the barks, the buds, the leaves, the flowers, and the fruits. The appearance of the bark is very different in many different sorts of trees and shrubs, as red, white, black, brown, and green, as in the dogwood, birch, oak, Guelder rose, and holly. It differs also in its properties, as in some it is firm, in others spongy, in some thin, in others thick, brittle, glutinous, or thready, as in the oak, the cork-tree, the beech, the Scotch fir, the hornbeam, the holly, the lime, and the elm. It varies likewise in its duration, the outer bark or coat in some trees being thrown off annually, as in the arbutus, the birch, &c.; while in others, for the most part, it is constantly retained or kept on. It differs equally in respect to its properties of taste, being in some astringent in its nature, in others sweet, bitter, resinous, &c., as in the oak and bramble, lime, abele, fir, &c. In regard to buds, some trees have none at all, as the pine and evergreen sorts; in some they are very large, in others very small, as in the horse-chestnut, and the willow. In some they are coated over with a covering of glutinous or resinous matter, as in the horse-chestnut, &c.; in others they are overspread with a dry film or tegument, as in the beech, &c. There are likewise some buds which are of a red colour; others which are yellow, black, brown, or red and greenish; as those in the lime, the willow, the ash, the beech, and the common fycamore, in the order in which they occur.

The variety in the leaves is still much greater; some being very broad, as those of the common laurel; others very narrow, as those of the larch. And there is a medium between these extremes, in those of the willow and the almond. In some they are entire, as in the bay; in others serrated, as in the cherry; and pinnatifid, as in the acacia, &c. In some again they are covered with down, as in the sea buckthorn; in others with wool, as in the hoary poplar; with prickles, as in the holly; with a glutinous matter, as in the gum cistus, &c. They are of all the different shades of green in the summer season; and of all the different tints of red and yellow, in the autumnal and vernal seasons.

There are some which retain their leaves and colours during or throughout the whole year, as the pine tribe, &c.; others which lose their green colour in the autumn; but retain their leaves all the winter, as the beech, hornbeam, &c. in particular circumstances. A great number of trees, among which are the elm and the ash, drop their leaves in the autumn, and are naked all the winter. In general, the leaves have the same properties as the barks, but in a fainter and less perfect degree; which are of much importance in some points of view. Those of the alder, the box, &c. are refused by most sorts of cattle; those of the elm, the thorn, &c. greedily devoured by them; while those of the fir tribe are offensive to many sorts of insects, which are liable to infest hot-houses, and other similar places.

And the flowers are much less various than the leaves. Those of some trees being large and showy, as of the rose, the honeysuckle, &c.; while those of others are small and obscure, as of the alaternus, &c. In some they cover the whole plant, and quickly fade away, as those of the hawthorn; while in others they are but thinly distributed, yet continue a considerable length of time, as those of the passion-flower, &c. There are some, which come into blossom at an early period, as those of the mezereon, almond, &c.;

&c.; others that are very late, as those of the sweet chestnut, the *althæa frutex*, &c. And there are some trees and shrubs which cease flowering before their leaves expand, as the almond; and others in which the blossom makes its appearance only when the leaves fall off, as that of the hazel.

In the fruits or seeds of trees and plants the variety is likewise considerable. There are some, in which they are brilliantly coloured and showy in their appearance, as in the clustered berries of the mountain-ash; while in others, the seed is very much hidden and obscure, as in the willow. On some trees they remain two or more years, as the cones on the fir tribe; on others but a few weeks, as the capsules of the elm. The fruits and seeds of some are used for culinary purposes, and contribute to increase and enrich the desserts of the table, as the apple, pear, walnut, &c.; while others are appropriated to and have the properties of fattening the inferior sorts of animals, as the acorn, the beech mast, &c.; and others again are poisonous, as the berries of the deadly nightshade, and those of the mezereon, &c.

Further, along with their characteristic distinctions, some trees and plants combine and comprise what may be considered particular properties.

In the roots, they are as much varied underneath the ground, as the trunks, stems, and branches are above the surface of it. There are some which spread themselves in a horizontal manner, as those of the pine, and fir tribes; others which send down perpendicular roots to a great depth, as those of the oak, the chestnut, &c.; and there are those which form a medium between these extremes, as in those of the lime, the beech, &c.

In the modes or means of propagation in trees and plants there is equal or more variety. There are some which are raised from seeds, as the most part of forest-trees, such as the oak, elm, ash, larch, &c.; others from layers, as the lime, platanus, rose, and many sorts of shrubs; still others from suckers, as the abele, gale, spirea, &c. And some are propagated by ingrafting, as the weeping ash, apple, &c.; others by inoculation, as the double-blossomed almond, the weeping cherry, &c. And some kinds, again, by the roots, as the thorn, mezereon, and others.

In respect to culture they require different kinds of soils, situations, and management; some delight in a deep, strong soil, as the oak; some in a dry gravelly one, as the beech; some in a deep moist one, as the poplar; others in a soil of the peat-earthly kind, as the erica, and various other sorts; still others are natural to a rather moist soil, as the alder, &c. And there are some trees which will grow in a soil of almost any sort, as the Scotch fir tribe; while others will scarcely grow in any, but that of their natural one, as the rhododendron, the andromeda, &c. There are some again which hardly stand in need of the aid or assistance of any sort of soil, as the ivy, &c.; while others are of the parasite kind, as the mistletoe, &c.

There is likewise much variety in the situations and exposures which trees and plants naturally affect. Some kinds will endure almost every sort of exposure, with the exception of that of strong powerful sea breezes, as the larch, the Scotch fir, the mountain-ash, &c.: while some again endure and withstand the sea breezes in a much better and far superior manner to others, as the sycamore, ash, service, elder, &c.; others will not prosper except in low, or sheltered situations, as the black spruce, moist sorts of American plants, &c.; while others will rise and grow under the drip and shade of others, as the Scotch elm, the Norway maple, hemlock, spruce, dogwood, box, &c.; but others again die in such situations, as the larch, the pine, the willow, and many other sorts.

In their more young growths trees and plants not only demand soils, situations, and aspects suited to their particular natures and habits, but also such methods of culture as are adapted to them. Some kinds requiring the earth and mould about their roots to be repeatedly dug up and stirred, as the lime, the lilac, &c.; others advance with equal rapidity, where the ground on the surface is preserved free and clean from other injurious vegetable productions, as the oak, the chestnut, &c.; while others again succeed in the best manner, where the surface of the land is covered with mossy matter, as the rhododendron, the erica, &c.

In regard to cutting and pruning, there are some trees which will not bear the knife, as the cherry, &c.; the wood in others is many times hurt by it, as in the pine and the fir tribes. Some again are capable of bearing it to any extent, as the hawthorn, the crab-apple, &c. However, these peculiarities are mostly applicable to trees of considerable height; as most sorts when very young endure cutting in, and pruning very well, many kinds requiring these operations to train and bring them to single stems. For instance, the silver fir, while in the nursery state, requires the side shoots of it to be cut and shortened; and young oak plants, some time after they have been finally planted out, are often cut over just above the surface of the ground, and supposed to grow up stronger by it.

A great many sorts of trees and plants stand in need of being removed or transplanted the first or second year of their growth from the seed, while in the nursery ground; and to be set out from that situation into plantations of different kinds, while under the height of four feet, or in their more early growth. There are some sorts which are little or not at all hurt by such removals, as the elm; while others are liable to die after it, as the spruce fir, the Weymouth pine, &c.; some kinds are also apt to die on being transplanted, after they are eight, ten, or more feet in height, as the pine, the fir tribes, &c.; while other sorts may be safely transplanted at nearly double such ages and sizes, as the lime, the elm, the sycamore, and various other deciduous kinds; however, a year or more before their removal is to take place, they should have their roots cut in, and their tops thinned by the pruning knife, or other means, as such precautions are highly important and necessary, and should never be omitted, in removing trees of the latter of the above heights.

In respect to the uses of trees and shrubby plants, though the latter sort are commonly set out for the purpose of ornament, variety, &c., and the former for that of timber, as well as these and other uses; there are still some other ways in which they occasionally contribute, and become of utility and importance to the planter. There are different products of some of them, which are useful in different arts and professions. For instance, the bark of some is useful in chemistry, for the making of bird-lime, as that of the holly; that of others, as of the lime, the elm, &c. for the manufacturers of mats. The leaves of some, as those of the mulberry, for the growers and raisers of silk. The blossoms of others, as those of the rose, for the apothecary, and those of the syringa for the confectioner. Those parts of the seeds of the beech which are proper, are converted into bread. And the fruits of others, as those of the pear, apple, plum, &c. are of very general utility and value. Some kinds of wood are of particular use and value for particular purposes, as the oak to ship-builders; and others might be trained for this application, as the larch, by bending down the stem when about twenty feet in height, securing it in that position, and then re-bending it again some considerable

able time afterwards, leaving the bole or trunk in a differently crooked state. The woody parts of the fir and pine are employed by house-carpenters, of the crab-tree by mill-wrights, of the ash by plough-wrights, of the beech, the walnut, the cherry, the plum, the box, the holly, the yew, and others, by the cabinet-makers. The lime is particularly useful to the carver, the sycamore to the turner, the box and holly to the mathematical instrument-maker, and the alder and the birch to the last and the heel-maker. Charcoal of any of the kinds is valuable for the iron-founders; that of the dog-wood, fallow, alder, hazel, &c. for the gunpowder manufacturers. The larch, the silver fir, &c. afford the coarse turpentine and its spirit; the spruce and pine tribes, resin, tar, pitch, lamp-black, &c. Most woods, but especially the beech, ash, elm, &c. afford potash. The sap-juice of some trees, as the birch, &c. yields a vinous liquor; and that of others, as of the fugar-maple, &c. affords fugar.

The value of wood as timber, and for other purposes, differs much according to local situation, and other circumstances; when near a dry-dock or ship-yard, oak, elm, &c. suited to ship-building, are of much higher value than when at a great distance in the country. The undergrowths of several sorts of trees, as dog-wood, fallow, willow, alder, &c. are of the most value when near large manufactories of gunpowder, being of little utility, except as fuel, when at a distance. Some sorts of wood, however, from the generality of their application and employment, are of great value in all situations, as those of the oak, the elm, the ash, the beech, and perhaps the larch has still more value than any of them. Others, on account of their scarcity, are also valuable in all places, as the box, the holly, the yew, &c. All the lighter products of some sorts of trees, as those of bird-lime, potash, turpentine, tar, pitch, &c. may likewise be considered of equal value in all situations. But a tree which would be of the greatest value in a particular situation or place, may not find in it that sort of soil that is suitable to its nature or habits of growth; in which circumstances that which will come to the most perfection in it, will commonly be found of the most value. Such woods as may not be valuable in consequence of local circumstances, may be rendered a great deal more high in their value, by having them manufactured in the places where they are met with, thus lessening the expences of conveyance, &c. In consequence of the great improvements in roads, canals, &c. and the general promotion of them, woods and plantations for timber, must, in almost all places, be valuable, and there can be few in which the other sorts of products will not be of great importance. In the measuring of standard trees for the purpose of ascertaining their value, though many think themselves fully qualified by being simply able to measure them; it is only by the perfect knowledge of the use and application of the different shapes, bends, and woods of them, that a correct estimate can be given; as a small portion of wood may be of little consequence in one sort of business, while it is of much in another, which is a secret of great interest and importance to the purchasers of timber of the standing kind.

In addition to these qualities, almost every tree and plant is possessed of various others, which excite emotions that have a relation to them, and which give their characters or expressions. For instance, the cypress is of a regular, invariable shape, or form, and always, in colour, of a dark green, having a still, solemn appearance; hence it has acquired the character of melancholy. A similar, but somewhat fainter, train of emotions, is produced in the mind by the falling branches, drooping spray, and yellow greenish colour of the weeping willow; hence it suits with scenes of

solitude, and induces meditation. In the light, airy form of the ash, and the bright white of the variegated holly, there are some traits of certain degrees of the cheerful kind; in the felicitous of the virgin's bower, ease and gracefulness; in the myrtle, delicacy and neatness; and in the sweep of the stem, the curve of the branches, &c. of the larch, a peculiar elegance. In the oak and the chestnut are forms which have long given the notions of grandeur and sublimity. Both these and other trees are particularly expressive of peculiar known characters, arising, in some degree, from their own nature, and in part from associations in the mind. Those of the cypress and yew kinds have been planted in burying grounds, and other similar places; the weeping willow, as the shade of urns; the laurel used as the crowa of warriors; and the chestnut introduced in landscapes.

Some accidental characters and expressions of plants are produced by novelty and singularity either in their natures, forms, or appearances; hence exotics are at first distinguished from those of the indigenous kind, and called beautiful, elegant, fanciful, strange, rare, &c. according to circumstances. The creeping ash, the stone pine, &c. derive and retain their characters from their comparative scarcity and unusual shape; while others have that of elegance and novelty in a much less degree, as the cedar of Libanus and the cypress; the hemlock spruce, and the scarlet oak, &c. Some trees and plants are common, and thought nothing of in one district or country, while, in others, they are uncommon, and thought highly of; thus, the weeping willow, the narrow-leaved elm, the acacia, &c., which abound, and are little valued, in the southern parts of the island; are scarce, highly esteemed, and termed elegant in those of the north; while the arbutus, the uva ursi, the erica alba, and even the mountain-ash, which are plentiful, unnoticed, and common in the north, are held in estimation, and thought highly elegant in the south.

These are some of the more particular qualities of trees and plants, which are concerned in the classification and arrangement of them, as the materials by which the objects of planting and ornamental gardening are to be accomplished, but there are others which are peculiar to them in other points of view, that it is quite unnecessary to notice in this place, as they are fully explained in speaking of them individually under their proper heads.

More ample information on the above subject may, however, be obtained by consulting Mr. Loudon's work "On Forming, Improving, and Managing Country Residences," in which will be seen their particular utility, and their most appropriate modes of application in the business of planting and ornamenting different kinds of pleasure grounds, under all the various circumstances which may occur in so far as their nature, situation, soil, and other similar particulars are concerned, as well as the picturesque effect which will be produced.

QUALITIES of Seeds, Sets, and Produce, the properties which are essential to them for the production of full and beneficial crops of the several different kinds, and the most perfect and advantageous states of growth and maturation of such crops, for their being consumed, either as food or otherwise. In all sorts of seeds of the grain kind, those which are the most fully bodied, bright, thinnest in the skin, and the most sound, without being too long kept, are the most suitable for making use of as seed. Such as are small, lean, ill fed, and shrunk in their skins, or which have been in any way heated in the mow or stack, are mostly quite improper for this purpose. Some have, however, supposed the contrary to be the case, but they have hitherto adduced no proofs whatever, of the fact, while the former opinion is supported

supported by the daily experience of the best farmers in the country. There is another circumstance which is of some importance in this business, which is that of the grain for this use being constantly newly threshed out from the straw, as such, for the most part, sprouts and grows more expeditiously, and is less liable to rot and perish in unfavourable seasons and situations.

All sorts of diseased grain, and such as is not perfectly free from the mixture of the seeds of weeds with it, should always be, as much as possible, avoided in this intention.

In regard to the smaller sorts of seeds for raising all kinds of plant-crops in the field, as well as those of the grass sort, both natural and artificial, the principal necessary qualities, in each, are those of their being of a bright, lively, shining colour, perfectly sound, and fresh, or lately collected from the plants. Such as are old, or kept more than a few months, are mostly improper for this application. The best sorts commonly slide freely over each other, without sticking or being heavy in the hand, and have a brilliant bloomy appearance.

In gardening, most sorts of seeds also are the best, and require to have these properties and qualities as much as possible; but there are a few which are apt to grow too luxuriantly for fruiting well, as some of the cucumber, melon, kidney-bean, and other kinds, which are better for being kept for some length of time, as this property is thereby in some measure corrected and restrained. Most sorts of nuts and stones, when used as seed, should, however, be employed in as fresh a state as possible.

Sets are different in their nature, being of the root or plant kinds. In the former, the sets or cuttings should have the eyes or buds in a perfect state, and be of a middling size, as both those which are very large and very small are objectionable. This is the case with the potatoe and some other sorts. In the latter, the plants should not have too large growths, but be in a fine young state of vegetation, so that they can be set out with facility, and readily take root again, having their heads or upper parts, for the production of the produce, wholly in an uninjured condition. They should also be quite newly drawn up, cut or slipped from the stalks of the old plants, without any sort of clubbing near the roots in those which are drawn. Such as have risen the most quickly from the seed, are, in general, the best. They should none of them ever be kept any great length of time after being drawn, before they are re-planted. This is equally applicable to the field and garden kinds. See SEED, SET, and SOWING.

The produce in all the white or grain crops, which are employed either for the purpose of mealing or malting, should constantly be well ripened; but where the straw is to be made use of as cattle food, the crops are better to be cut before they have reached the state of full maturity, as this purpose is thereby more completely answered. There is much loss in the produce of most sorts of field plant-crops, by taking them before they have formed their bulbs or heads in a perfect manner. But many of such like products, in the garden, are the best and most advantageously taken in such imperfect states, being tough and coarse when full grown, and without the necessary tenderness. Others require to be cut or drawn early in order to have the proper degrees of sweetness and flavour. The fruit kind of produce is taken both before and when nearly ripe, according to the uses for which it is intended. Some sorts of vegetable produce are used quite in their green state, as food; while others are best in a somewhat more advanced state: and others, again, in both these states. And there are those which require to be well ripened,

and kept for some length of time before they are used in this way.

All sorts of produce of the grass-kind, are cut and used to the most benefit, when they are taken a little before they become perfectly ripe, as they go the farther, whether they are to be consumed in the green state, or in that of hay. This is equally the case with the more luxuriant artificial sorts, as with those of less growth, of the natural kind. This is explained more fully in speaking of the different plants and crops individually, and in the article HAY; which see.

QUALO, in *Geography*, a town on the N.E. coast of Sumatra. N. lat. $2^{\circ}45'$. E. long. $99^{\circ}40'$.

QUALUGA, a town of Africa, in the country of Whidah; 18 miles N.W. of Sabi.

QUAM, a town of Norway, in the diocese of Drontheim; 68 miles N. of Drontheim.

QUAM *diu se bene gesserit*, a clause frequent in letters patent, or grants of offices, to secure them so long as the person they are granted to shall not be guilty of abusing the same.

Thus, *e. gr.* we find it in those given to the barons of the exchequer: where it intimates, that they shall hold the same as long as they shall behave themselves well; which is to be restrained to matters of their offices; and signifies no more than the law would have implied, had the office been granted expressly for life. See JUDGE.

A grant therefore, with this clause, is equivalent to a grant for life.

QUAMASH, in *Botany*, a name given, by the North American Indians, to a plant called *Phalangium Quamash*, by Mr. Pursh, in his *Flora*, v. 1. 226; who nevertheless mentions an irregularity in the petals, that might possibly establish it as a new genus. See PHALANGIUM.

This plant was observed by governor Lewis, about the upper part of the Missouri, near the Rocky-mountains, flowering in June. The *bulb* is roundish, tunicated. *Stem* none. *Leaves* radical, few, long, and linear, half an inch broad, smooth; keeled underneath. *Flower-stalk* solitary, naked, erect, round, smooth, unbranched, a foot or more in height, terminating in a *spike*, or rather *cluster*, of large, pale-blue *flowers*, each accompanied by a linear, membranous, withering *bractea*, longer than the partial stalk. *Petals* linear-lanceolate, nearly equal in length; five of them ascending; the sixth deflexed.

The bulbs are carefully collected by the natives, and cooked between heated stones, when they assume the appearance of baked pears, and have an agreeable sweet taste. They form a great part of the winter stores of these Indians. Though governor Lewis's party found them a pleasant sort of food, they could not be eaten, in any quantity, without causing bowel complaints.

QUAMOCLIT, an Indian name, retained by Plumier and Tournefort as generic; but by Linnæus used only as the specific appellation of a beautiful species of *IPOMÆA*; see that article.

QUAMPEAGAN FALLS, in *Geography*, falls in America at the head of the tide on Newichwanock river, which joins Piscataqua river, 10 miles from the sea; so called by the natives, because fish were there taken with nets. At these falls are a set of saw-mills and others, and also a landing-place, where great quantities of lumber are rafted. Here the river has the English name of Salmon Falls river, from the number of salmon caught there. On many places from Quampeagan to the pond, from which it issues, there are mills for boards and corn.

QUAM-TOM, a town of China, of the third rank, ia

in the province of Yun-nan; 15 miles N.E. of Tchou-hiong.

QUAN, a town of China, of the third rank, in Chan-tong; 22 miles W. of Tong-tchang.

QUAN, or *Guan*, in *Ornithology*. See *PENELOPE Cristata*.

QUANAMORA, in *Geography*, a town of Africa, in Upper Guinea, on the banks of the Scherbro', said to contain 5000 families. N. lat. $7^{\circ} 45'$. W. long. $10^{\circ} 15'$.

QUANDROS, a name given by writers of the middle ages to a stone to which they attribute great virtues, and which, they say, is found in the head of a vulture.

QUANG-LING, in *Geography*, a town of China, of the third rank, in Chan-fi; 15 miles W.S.W. of Ouei.

QUANG-NING, a town of China, of the third rank, in Quang-tong; 35 miles N. of Tchao-king.

QUANG-PING, a city of China, of the first rank, situated in the northern part of the province of Pe-tche-li, between the provinces of Chang-tong and Ho-nan, which has nine towns of the third class dependent upon it. All its plains are well watered by rivers. Among its temples, one is dedicated to those men, who, as the Chinese pretend, discovered the secret of rendering themselves immortal; 212 miles S.S.W. of Peking. N. lat. $36^{\circ} 47'$. E. long. $114^{\circ} 29'$.

QUANG-PUNG, a town of China, of the third rank, in Pe-tche-li; 17 miles N.W. of Tay-ming.

QUANG-SI, a province of China, situated between those of Quang-tong, Hou-quang, Koei-tcheou, Yun-nan, and the kingdom of Tong-king; about 360 miles from E. to W., and 230 from N. to S. In commerce, as well as extent, it is not equal to that of the other provinces; and yet it so abounds with rice, as to supply, for six months in the year, the province of Quang-tong, without which the inhabitants of this province could not subsist. The mountains with which it is covered, abound with mines of gold, silver, copper, and tin, and in this province is a singular kind of tree, containing a soft pulp, which yields a sort of flour, and of this flour they make a very good bread. Besides parrots, hedge-hogs, and the rhinoceros, wild animals, curious birds, and uncommon insects are found here in great number. This province contains twelve towns of the first class, and eighty of the second and third. Its capital is Kwei-ling. *Groslier's China*, vol. i.

The population of this province is estimated by sir George Staunton at 10,000,000; its extent is said to comprehend 78,250 square miles, or 50,080,000 acres. The revenue transferred from it to the treasury at Peking, comprising land, salt, and taxes, is stated at 500,000 tahels, or ounces of silver.

QUANG-TCHANG, a town of China, of the third rank, in the province of Chan-fi; 28 miles S. of Ouei.

QUANG-TCHEOU, or QUANG-CHOU-FOU, a city of China, of the first rank, in the province of *Quang-tong*, usually called by the Europeans *Canton*; which see.

QUANG-TONG, the most considerable of the southern provinces of China; bounded on the N.E. by Fokien, on the N. by Kiang-fi, on the W. by Quang-fi, and the kingdom of Tong-king; the rest is washed by the sea. The country is diversified with plains and mountains, and the land is so fertile that it produces two crops every year. Trade and the fecundity of the soil supply this province with every thing that can contribute to the pleasures of life; it furnishes gold, precious stones, silk, pearls, eagle-wood, tin, quicksilver, sugar, copper, iron, steel, saltpetre, ebony, and abundance of aromatic woods, which are much valued. Besides European and Indian fruits, it produces several that are peculiar to itself. All the coasts abound

with fish, and furnish great quantities of oysters, crabs, and tortoises of an immense size: of the shells of these the Chinese make several pretty toys. Tame ducks are reared in this province in great numbers: the Chinese are industrious in breeding them, and they hatch their eggs in ovens or dunghills, though they do not seem to have derived this mode of breeding them from Egypt, where it is practised. They carry them on barks in large flocks to feed on the sea-shore, where, at low water, they find shrimps, oysters, and other kinds of shell-fish. At the approach of night they are collected together by only beating on a basin, upon which they immediately form themselves into different flocks, and each returns to the vessel to which it belongs. The Chinese have a method of salting their meat without injuring its flavour, and they salt their eggs by enclosing them in a coat of clay mixed with salt. These salted eggs are said to be very wholesome, and even sick persons are permitted to eat them. Although the climate of this province is warm, the air is pure, and the people are robust and healthy. They are noted for their industry, and for a talent of imitation, which they possess in an eminent degree. As this province is at a great distance from court, its government is one of the most important, and it is also one of the most flourishing in the empire. Its viceroy has also the command of Quang-fi, and resides at Cheo-king, for the convenience of expediting his orders to either of these provinces. This governor always has a number of troops ready, properly posted, to check the incursions of robbers and pirates, who might otherwise interrupt and injure trade: for the same purpose, a great number of fortresses (most of them being cities provided with numerous garrisons) have been built along the coasts and in the interior parts of the country. This province is divided into 10 districts, which contain 10 cities of the first class, and 84 of the second and third. *Groslier*.

The number of inhabitants, according to sir George Staunton's estimate, is 21,000,000; its area comprehends 79,456 square miles, or 50,851,840 acres. The revenue remitted to the imperial treasury at Peking, and raised from land, salt, and taxes, amounts to 1,340,000 tahels, or ounces of silver. The military force is said to amount to 50,000 men. Its capital is *Canton*; which see.

QUANG-YANG, a town of China, of the third rank, in the province of Quang-fi; 30 miles S. of Tsuen.

QUANG-YUEN, a town of China, of the third rank, in the province of Se-tchuen, seated on the Kialing; 50 miles N. of Pao-king.

QUANNEFIORD, a bay on the W. coast of West Greenland. N. lat. $62^{\circ} 10'$. W. long. $48^{\circ} 5'$.

QUANO, a town of Japan, on the island of Nippon, on the S. coast, 70 miles E. of Meaco. N. lat. $35^{\circ} 58'$. E. long. $136^{\circ} 14'$.

QUANTALLA, an island of Africa, at the mouth of the Zaire, celebrated for a silver idol, to which the neighbouring kings send presents and offer sacrifices.

QUAN-TAO, a town of China, of the third rank, in Chan-tong; 25 miles W.N.W. of Tong-tchang.

QUAN-TCHANG, a town of China, in Chan-tong; 13 miles N. of Po.

QUANTITE', Fr. This word in music, like prosody, does not fix the number of notes or of syllables, but their relative duration. Quantity produces the rhythm, as accent produces intonation. Rhythm and intonation generate melody. *Rouilleau*. See *MELODY*.

QUANTITY, QUANTITAS, any thing capable of estimation or mensuration; or, which being compared with another

other thing of the same kind, may be said to be greater or less than it; equal, or unequal, to it.

Mathematics is the science or doctrine of quantity.

Quantity is a general attribute, applied in a very different manner to things of very different nature; whence it is impossible to give any universal definition of it.

Quantity is applied both to things and to modes; and this either singularly to one; or plurally, to several. In the first case it is called *magnitude*, in the latter *multitude*.

Quantity may be reduced to four classes; *viz.*

QUANTITY, *Moral*, which depends on the manners of men, and the free determination of their wills. As the prices and value of things; degrees of dignity and power, good and evil, merit and demerit, rewards and punishments, &c.

QUANTITY, *Notional*, arising from the operation of the understanding only. Such as the largeness or narrowness of the capacity of the mind, and its conceptions. In *Logic*, universals, predicaments, &c. In *Grammar*, the quantity or measure of syllables, accents, tones, &c.

QUANTITY, *Physical*, or *Natural*, which is of two kinds: 1. That which nature furnishes us with in matter, and its extension. And, 2. In the powers and properties of natural bodies: as gravity, motion, light, heat, cold, rarity, density, &c.

QUANTITY, *Transcendental*, as duration, the continuation of any being, existence, time, &c.

QUANTITY is also popularly distinguished into *continued* and *discrete*.

QUANTITY, *Continued*, or *Continuous*, is when the parts are connected together, and is commonly called *magnitude*. This, again, is of two kinds; either *successive*, or *improper*, as time.

QUANTITY, *Discrete*, is when the parts of which it consists exist distinctly, and unconnected together; which makes what we call *number* or *multitude*.

The notion of continued quantity, and its difference from discrete, appears to some without foundation. Mr. Machin considers all mathematical quantity, or that for which any symbol is put, as nothing else but number, with regard to some measure, which is considered as one; for that we cannot know precisely how much any thing is, but by means of number. The notion of continued quantity, without regard to any measure, is indistinct and confused; and though some species of such quantity, considered physically, may be described by motion, as lines by the motion of points, and surfaces by the motion of lines; yet the magnitudes, or mathematical quantities, are not made by the motion, but by numbering according to a measure. Vide *Phil. Trans.* N^o 447. p. 228.

Permanent quantity is farther distinguishable into length, breadth, and depth.

Wolffius seems to give us a more precise notion of mathematical quantity, and its two species of discrete and continued. Whatever is referred to unity in the same manner as one right line to another, is what we call quantity; or number in general.

If, now, the thing be referred to a given unit, as 3, it is called a determinate number: if to unity in the general, or at large, it is called a quantity; which, on this principle, is the same with indeterminate number.

Thus, *e. gr.* the breadth of a river is accounted a quantity: if, then, it be enquired how great it is; to conceive its quantity, we take some unit at pleasure, and see the relation of the breadth to it; and according to the different unit assumed, we express the breadth of the river in a different determinate number.

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The breadth of the river, therefore, is quantity considered as referred to a vague unit, or to unity at large; but the unit being determined, the thing is understood by a determinate number.

In this sense, algebra is the arithmetic of quantities. See on the subject of quantity, Harris's *Philosophical Arrangements*, chap. ix.

QUANTITY of *Action*. See ACTION.

QUANTITY, *Impossible*, and *Imaginary*. See ROOT.

QUANTITY of *Curvature* at any point of a curve is determined by the circle of curvature at that point, and is reciprocally proportional to its radius. Newton's *Meth. of Flux. and Inf. Series*, p. 60. Maclaurin's *Fluxions*, b. i. c. xi. See CURVATURE and EVOLUTE.

QUANTITY of *Motion*, in *Mechanics*, is of two kinds; *viz.* of momentary motion, and of entire motion.

QUANTITY of *entire motion*. The Cartesians define the entire motion as the momentary one, by the factum of the mass, or quantity of matter, into the velocity; but since motion is a successive being, and has no parts co-existing together, its quantity ought to be estimated by the aggregate of the several parts existing successively; and is therefore equal to the factum of the momenta into the time.

QUANTITY of *momentary motion* is the factum of the velocity into the mass; or it is a measure arising from the joint consideration of the quantity of matter, and the velocity of the motion of the body; the motion of any whole being the sum or aggregate of the motion in all its several parts.

Hence, in a body twice as great as another, moved with an equal velocity, the quantity of motion is double; if the velocity be double also, the quantity of the motion will be quadruple. Hence, the quantity of momentary motion coincides with what we call the momentum, or impetus of a moving body. See FORCE.

In the collision of bodies, the quantity of momentary motion, which is found by taking the sum of motions tending the same way, or their difference, if they tend towards contrary parts, is not at all changed by any actions of the bodies on one another. See PERCUSSION.

QUANTITY of *Matter* in any body, is the product of the density into the bulk; or a quantity arising from the joint consideration of its magnitude and density.

As, if a body be twice as dense, and take up twice as much space as another, it will be four times as great.

This quantity of matter is the best discoverable by the absolute weight of bodies. See MATTER.

QUANTITY, *Infinite*. See INFINITE Quantity.

QUANTITIES, in *Algebra*, are indeterminate numbers, or things referred to unity in general. See NUMBER.

QUANTITIES are properly the subject of algebra; which is wholly conversant in the computation of such quantities.

Given quantities are used to be noted by the first letters of the alphabet *a, b, c, d*, &c. the quantities sought by the last, *x, y, z*, &c. See CHARACTERS.

Algebraical quantities are chiefly of two kinds; *positive*, and *negative*.

QUANTITIES, *Positive*, or *Affirmative*, are those which are greater than nothing, and which are affected with the sign + prefixed; or supposed to be so.

QUANTITIES, *Negative*, or *Privative*, are those less than nothing: which are affected with the sign - prefixed.

Hence, 1. Since + is the sign of addition, and - the sign of subtraction; a positive quantity is produced by adding any real quantity to nothing: *e. gr.* $0 + 3 = + 3$; and $0 + a = + a$. And a privative quantity is produced

A a

by

by subtracting any real quantity out of nothing ; *e. gr.*
 $0 - 3 = -3$; and $0 - a = -a$.

For an illustration. Suppose when you are quite destitute of money, somebody gives you a hundred pieces ; you have then a hundred pieces more than nothing ; which pieces constitute a positive quantity.

On the contrary, suppose you have no money, yet owe a hundred pieces ; you have then a hundred pieces less than nothing ; for you must pay a hundred pieces to have just nothing. This debt is a negative quantity.

Thus in local motion, progress may be called a positive quantity, and regress a negative one ; because the first increases, and the second diminishes the space passed over.

And in geometry, if a line drawn towards any part be accounted an affirmative quantity, another the contrary way will be a negative one.

Privative or negative quantities, therefore, are equally real with positive quantities, but opposite to each other, so as to take away each other's effect, in any operation, when they are equal as to quantity. Thus $3 - 3 = 0$, and $a - a = 0$. However, though $+a$, and $-a$, are equal as to quantity, we do not suppose in algebra, that $+a = -a$; because to infer equality in this science, they must not only be equal as to quantity, but of the same quality, that in every operation the one may have the same effect as the other. A negative quantity is said to be less than nothing, because it is opposite to the positive, and diminishes it when joined to it ; whereas the addition of 0 has no effect. But a negative is to be considered no less as a real quantity than a positive. Quantities that have no sign prefixed to them are understood to be positive. See **NEGATIVE SIGN**.

QUANTITIES, *commensurable, compound, exponential, heterogeneous, like, rational, simple, transcendental, and variable.* See the adjectives.

QUANTITIES, *Addition of.* 1. If the quantities denoted by the same letter be affected with the same sign, the numbers prefixed to them are added as in common arithmetic.

2. If they be affected with different signs, the addition is changed into subtraction ; and to the remainder is prefixed the sign of the greater.

3. Quantities denoted by different letters, are added by means of the sign $+$; as in the following example :

$$\begin{array}{r} 4a + 2b - 2c - 5d - g \\ 5a - 2b + 6c + 2d - 3g \\ \hline 9a + 4c - 3d - 4g \end{array} \qquad \begin{array}{r} a - b \\ a \\ \hline a - b + a \end{array}$$

See **ADDITION**.

QUANTITIES, *Subtraction of.* See **SUBTRACTION**.

QUANTITIES, *Multiplication and Division of.* See **MULTIPLICATION**, and **DIVISION**.

QUANTITIES, *Combination of.* See **COMBINATION**.

1. If a positive quantity be multiplied or divided by another positive quantity, the result is also a positive quantity.

2. If a negative quantity be multiplied or divided by a positive, the result is a negative.

3. If a negative quantity be multiplied or divided by another negative, the result is a positive.

4. If a positive quantity be multiplied or divided by a negative, the result is a negative quantity. See **MULTIPLICATION**, in *Algebra*.

QUANTITY of a Degree. See **DEGREE**.

QUANTITY of an Eclipse. See **ECLIPSE**.

QUANTITIES of Seed, Sets, and Plants, in *Agriculture*, the proportions of each, which are necessary for raising good crops of the different kinds. The ascertaining of the most useful and beneficial quantities, in the several cases,

depends, in a material degree, upon a number of different circumstances, such as those of the situation, the nature and quality of the soil, the period of sowing, the state of the season, the manner of putting them into the earth, and several others.

A great deal more seed, sets, and plants, are requisite in late situations or backward seasons, heavy, wet, stiff lands, and late sowings ; than where they are more forward, more light and dry, and put in early. And far less quantities made use of in the drill and dibble methods of putting in the crops, than in that of the broadcast, or by the hand.

In most sorts of white, or grain crops, the quantities are from two to five bushels *per acre*, being more in barley and oats, than in those of the other kinds, as from three to five in general.

In those of the pulse kinds, usually from six or seven pecks, to two, three and a half, and four bushels, being commonly the latter, or more, in some sorts of beans.

In those of the small seed description, as the buck-wheat and turnip sorts, from one to two and three pounds ; but in the cabbage kind, only from six ounces to half a pound, and a quarter or half a peck.

In the tap-rooted crops, as the carrot, parsnip, mangel-wurzel, &c. from two to five pounds, and sometimes six. In lettuce crops, in the field, from three to four pounds the acre.

In different sorts of plantation crops, as those of hemp, flax, woad, weld, teasel, &c. from two to three up to five or six bushels, in the three first ; but only from two to four quarts, and from one to two pecks, in the two last.

The sets in the hop, madder, liquorice, and lavender kinds, are from six to seven hundred, and a thousand or more, in the first, and two last ; but in the madder from fifteen to twenty thousand *per acre*. In the cabbage sort, from eight hundred to a thousand and more plants or sets to the acre. And in the potatoe the quantity of sets vary from eight to twenty or more bushels to the acre, according to the soil and manner of their being put into the ground.

The quantities of natural grass seeds which are generally employed upon the acre, are from two to four bushels and upwards. And those of the artificial grass kinds, in the clovers from ten to eighteen pounds ; in saintfoin from three to four bushels ; in lucern from sixteen to eighteen pounds ; tares from two to three bushels ; trefoil, three pottles of cleaned seed, or two bushels of the uncleaned sort. And in chicory from eight to twelve pounds. See **SEED**, **SET**, **PLANT**, and **SOWING**.

The subject is more fully explained in speaking of the culture of the different sorts of crops, and the most suitable quantities under different circumstances put down.

QUANTITY, in *Grammar*, denotes the measure and magnitude of the syllables ; or that which determines them to be called long, or short ; or, it is the measure of time requisite for the distinct pronunciation of a syllable.

This quantity is the object of prosody ; and it is the regard to this that distinguishes verse from prose.

The economy and arrangement of the quantities, *i. e.* the distribution of long and short syllables, make what we call the *number*.

The quantities are used to be distinguished among grammarians by the characters short and long.

The proportion between the long and short syllables may be generally fixed the same as that between the crotchet and quaver in music ; *viz.* as two to one. See **TIME**.

Syllables are long or short, either by their nature, or by accident ; that is, on account of the place where they are

put and the letters that follow them, which is called position.

In most languages, there are some syllables whose quantities vary, as the measure requires, which are called common; as in the English record and rēcōrd.

Some authors confound the quantity with the accent; but the difference is very evident; the former being the length or shortness of a syllable, the latter the raising or falling of the voice.

From two quantities, viz. long and short syllables, arise all the varieties of poetic feet, which are very great. Horace alone uses no less than twenty-eight. Yet the Greeks went vastly beyond the Romans in this respect. In effect, as many ways as two quantities may be varied by composition and transposition, from two to six syllables, so many different feet have the Greek poets contrived, and that under distinct names, to the number of 124. Though it is the opinion of some of the learned, that poetical numbers may be sufficiently explained from the feet of two or three syllables, into which the rest may be resolved.

The feet, formed by the ancients of the long and short syllables immediately, are the *spondee*, consisting of two long syllables; the *pyrrhic*, of two short ones; the *trochee*, of a long and short syllable; and the *iambic*, of a short and long syllable.

Those of three syllables are the *molossus*, consisting of three long syllables; the *tribrach*, of three short ones; the *dactyl*, of one long and two short syllables; and the *anapest*, of two short and one long syllable.

The English tongue admits of no feet above two syllables, though both the Latin and Greek allow of six.

Our heroic verses consist of five long and five short syllables intermixed alternately; though not so strictly but that the order may be dispensed with. Dryden varies them with admirable beauty; frequently his heroic verse begins with a long syllable followed by two short ones.

The truth is, the quantity of the syllables is but little fixed in the modern tongues; and there is still less regard had to it in the composition of modern verses. The want of feet, or rather the shortness and uniformity of our feet, makes great difference between the numbers of the ancient and modern verse. Our poets are fettered; and their fetters are so short, consisting of but two poor links, that it is no wonder they can make no extraordinary motions.

The ancients subsisted by their quantities alone; so well were they distinguished, and such a variety and harmony did they afford! Our quantities make such poor music, that we are forced to call in the Gothic aid of rhyme to distinguish our verse from prose.

Yet have attempts been made to settle our verse on the ancient and natural footing of quantities, in exclusion of rhyme, and with such success too (witness the immortal Paradise Lost) as seems to leave the practice of rhyming inexcusable. The French have likewise attempted the same in their tongue, particularly Jodelet, and after him Pasquier, Passerat, and Rapin; but they have all failed.

On Quantity in the Greek Language.

Rules for the determination of quantity in the Greek language, chiefly relate to the doubtful vowels *α*, *ι*, *υ*, since *ε*, *ο*, are, by nature, or not affected by position, short; and *η*, *ω*, are, by nature, or not affected by position, long.

Position.

1. A syllable in which a short or doubtful vowel precedes two consonants or a double letter, is long in every situation; as *δαινῆ* δε κλειγγῆ, αὐτὰρ ἐμὲ Ζεὺς, κατὰ φρένα, πατρός, τέκνον. Hom.

1. Except that a short vowel before two consonants, whereof the former is a mute and the latter a liquid, is common; as

Ἄλλ' ἐπιλέκτρον ἰν, ἄκρον δ' ἄκρυν καταδάκνυ. Hom. βατραχ. v. 45.

Μέτρεα δευεχε θείουσι, το γὰρ μέτρον ἐστὶν αἰετον. Phocyl. v. 92.

Note.—1. In pastoral, elegiac, and epigrammatic verse, the syllable is more frequently short.

2. In dramatic poetry we may observe, 1st, that a short vowel before a short or aspirate mute followed by a liquid, and before a middle mute followed by *ρ*, remains short. In tragedy the syllable, if not final, is often long. 2dly A short vowel before a middle mute followed by *λ*, *μ*, or *ν*, lengthens the syllable in all dramatic poetry.

3. When the syllable is lengthened before two consonants, the vowel in pronunciation assumes one of them; as *δέκ-λαγγῆ*; *ἰμέσ-Δεύς*, *κατὰφ-ρένα*, *πῶτ-ρός*, *τέκ-νον*. Hom. When the syllable remains short the vowel concludes it; as *πῶ-προς*, *τέ-κον*.

2. A short vowel is sometimes made long before a single consonant, particularly before a liquid, as *πολλά λιτοσμήνα*, Hom.; *παρὰ ῥηγμῖνι*, Hom.

Note.—It is generally long before *ρ*, which with its aspirate appears to have been doubled in pronunciation; as *παρῶρρημῖνι*. This licence is not confined to a liquid; as *ἐπιδῆ*, *ῥφιν* &c. Hec.

3. A short syllable is often made long when the next word begins with a digammated vowel, as *ὦ; οἱ*, for *Φοι*. Hom. *Μέλανδς οἶνα* for *Φεινα*. Hom. *Ὀυδῆ οὐς* for *Φούς*. Hom.

4. When three short syllables come together, it is necessary, on account of the measure in heroic verse, that one should be made long; as *ἀθίατοι*, *Πειριμῖδι*.

Note.—This takes place even where the three syllables are in different words; as *διὰ μῖν*, Hom.; *δρὺς ἔλυμα*, Hec.

5. A vowel before another does not suffer elision, as in Latin, at the end of a word, unless an apostrophe is substituted.

Note.—The elision of diphthongs takes place in verbs only; real instances of this are to be found only in the fragments of the new comedy.

6. A long vowel, or a diphthong, is generally shortened at the end, and sometimes at the beginning, of a word, before a vowel; as *οἰκῶ ἐν*, Hom.; *πᾶσι*, Soph.; *ἡ ζῶσι* *εἰρέι*, Theocr.

Note.—A long vowel, or a diphthong, may be considered as consisting of two short vowels. If the latter is supposed to suffer elision, the former will of course remain short; as *οἰκῶ ἐν*.

Crafsis, or Contraction.

7. A contracted syllable is always long; as *ὄφεις*, *ὄφει*; *ἱερός*, *ἱεός*.

8. Two successive vowels, forming two syllables, even in different words, frequently coalesce in poetry; thus *θεός* becomes a monosyllable, *κρυσίω* a dissyllable, and in *ἡ λάβειτ'*, *ἡ οὐκ ἐνόησεν*, Hom.; *ἡ οὐκ* are pronounced as one syllable.

Composition and Derivation.

9. Compound and derivative words follow the quantity of their primitives; as *ἄτιμος* from *τίμη*, *φύγη* from *ἐφύγον*; *νίκων* from *νικη*.

Note.—Grammarians have sometimes complained that “non semper hic regula fidendum.” But Dr. S. Clarke affirms;—“Derivata pro eo, a qua parte fluunt penultimam similiter vel perpetuo corripunt, vel perpetuo produciunt. Latini habent *lēgo*, *lēgi*, quasi contractum ex *lēgēi*. Similiter *sēdeo*, *sēdi*, indeque *sēdes*, *sēdile*. Cuiusmodi quādam ratione, apud Græcos fit. Verba nimirum innumera sunt, quæ in præsentibus et imperfectis omnibus et in aoristis primis, activis et mediis, semper produciuntur: in futuris autem et aoristis secundis omnibus, semper corripuntur; ut *φαίνομαι*, *ἐφαίνομαι*, *ἐφηναι*; *φάνω*, *ἐφώνω*, *ἐφώνηκην*, indeque *φῶσις*, *φῶνερός*, &c. *Κρίνω*, *ἐκρίνω*, *ἐκρίνα*; *κρίνω*, indeque *κρίσις*, *κρίσις*, *κρίσις*, &c.

According to the same analogy, μαρτύρομαι, μαρτύρομαι, and μαρτυρόμεν, always lengthen the antepenultimate; as in Eurip. Med. 22. 619. 1410; Aristoph. Acharn 926. Nub 495, &c. though μαρτυρόμαι, and its derivative μαρτύρεω, shorten that syllable; as in Aristoph. Eccl. 557, Sophocles. Antigone. 525. In the same manner, κύρω fut κύρω, gives rise to κύρωσι and κύρωω, &c.

10. Α, privative, is short, as ἀτίμος; but long in ἀθανάτος.
11. Ἀγι, ἐξι, βξι, δι; ζα, in compoition, are short; as ζᾶθος.

Of the Increments of Nouns and Adjectives.

12. The penultimate increase, Λ , of nouns and adjectives is short; as $\sigma\acute{\omega}\mu\alpha\tilde{\iota}\tau\omicron\varsigma$.

1. Except nouns in *αι-αντος*; as *τιται*, *τιτάνος*.
2. And the Doric genitive; as *Ατρεΐδου*, *μουσαίου* for *μουσαίου*.
3. Also, *κέρει*, *κέρειτος*; *κράς*, *κράτος*; *ψάς*, *ψάρος*; *βράς*, *βράκος*; *κράς*, *κράκος*; *κόρηας*, *κορηάκος*; *νέας*, *νέακος*; *φας*, *φάρος*; *σύσφας*, *συσφάκος*; *Φαίας*, *Φαίακος*; *φίνας*, *φίνακος*, are long.
13. The penultimate increase, *ι*, of nouns and adjectives, is short; as *ἐγς*, *ἐγίδος*.
 1. Except in words of two terminations; as *δελφίς*, *δελφίδος*.
 2. And monosyllables; as *βίς*, *βινός*; but *Δίς*, *Διδός*; *θρίς*, *θρίκος*; *σπίς*, *σπίνκος*; *τίς*, *τινός*, are short.
 3. Also nouns making *-δος* or *-θος*; as *κρημής*, *κρημίνος*; *ὄρεως*, *ὄρεϊνός*.
 4. Nouns in *-ς*, *-γος*, or *-κος*; as *μάστις*, *μαστίγος*; *ζωίνης*, *ζωίνος*.
 5. Monosyllables in *-ψ*, *-πος*; as *θρίψ*, *θρίπος*.

14. The penultimate increase, τ , of nouns and adjectives, is short ; as $\pi\tilde{\upsilon}\xi$, $\pi\tilde{\upsilon}\xi\acute{o}\varsigma$.

1. Except in words of two terminations; as *φέρων* and *φέρεις*, with *κέρυξ*, *κέρυκος*.
2. *Γρύψ*, *γρυπός*; *γύψ*, *γυπός*; *βεδρυξ*, *βηδρυκος*; are common.

Increment of Verbs.

15. The quantity of all tenses generally remains the same, as in the tense from which they are formed; as from κερῶ are formed ἐκρῶν, κερῶμαι, ἐκρῶμην; from κρήω are formed κρήϊον, κρήϊμαι, ἐκρήϊον.

16. The *perfect* follows the quantity of the first future ;
as $\phi\acute{\upsilon}\omega$, $\epsilon\upsilon\sigma\omega$, $\pi\acute{\epsilon}\phi\upsilon\kappa\alpha$.

17. Verbs in $\pi\tau\omega$, except $\pi\acute{\iota}\pi\iota\omega$, $\beta\acute{\iota}\pi\iota\omega$, and those in $\nu\pi\iota\omega$, shorten the penultima of the perfect.

18. In the Attic reduplication the penultima is short ; as ἐρίζω, ἡρίκκω, ἐρήρεκα.

19. The *perfect middle* follows the quantity of the second aorist: as *ἔτυπον, τέτυπα*; except *βεβήθα, ἔβηγα, κέκωγα, κέκωγα, μέμνηα, πέπρωγα, πεφύκα, τέτειγα*.

20. The doubtful vowels before σ are long; as $\tau\epsilon\tau\iota\phi\acute{\alpha}\sigma\iota$,
 $\delta\iota\alpha\chi\epsilon\upsilon\sigma\iota$.

21. In the *first aorist* participle, $\alpha\tau\tau$ is long.
22. In the *imperative* of verbs in $\mu\iota$, u is short in polysylla-

23. In the *first future*, α, ι, and υ followed by σω, are short;

24. But *ατω* is long before from verbs in *αω* preceded by

a vowel, or in *grw*, as *θεῶω*, *θεῶωσι*; *δραῶ*, *δραῶσι*. *ισω* and *υσω* are long from verbs in *ω* pure; as *τίω*, *τίσω*; *ισχύω*, *ισχύωσι*.

The Quantity of doubtful Vowels in the First or Middle Syllables.

25. Α, ι, υ, before vowels, are generally short; as Ἠνῶχοι
βροῶντες, ἔφισαν ὅλας ἡπυους. Hesiod.

1. Except A, the penultimate of nouns in *āu* increasing by *o*, and feminine proper names in *āi*, are long; as *Μαχάωv*, *Θαί.* Also in *āiz*, *ἀις*, *κραις*, *λαῖς*, *χαῖς*; *πῶος*; likewise the antepenultimate of *ἄατε*, *ἀαρῆατος*, *ἄισσα*, *Ἀλάνας*, *Ἰλιονες*, *Ἀἰγῆτι*, *Βιάζομαι*, *Πηγῆας*, &c.

2. I, the penultimate of nouns in *ων*, *ος*, is long; (except comparatives); as *βραχύνω*, ἄρτιον. Also in *κρινος*, κινῆς, ἰσχυρία, ὕψους, ἵππων, παλιούρις, πύρις. But the penultimate of nouns in *αι* are accounted common; as *σωφία*, καλῶν. Likewise *ει* is said to be common in such: λείων, ἱερμῶν, ἡρώδης, θέρμαι, θέρων, δισαν, μνηστῶν, δάκτυλων, ποταμών.

3. τ is long in $\epsilon\tau\alpha$, $\delta\tau\alpha\varsigma$, $\iota\gamma\tau\eta$, $\mu\eta\tau\eta\varsigma$, $\mu\tau\omega$, $\pi\lambda\chi\tau\omega\zeta$, $\upsilon\epsilon\tau\omicron$, $\chi\upsilon\alpha\tau\omicron\varsigma$.

26. Α, ι, υ, before final $\mu\alpha$ in neuter nouns, are long ;
as $\theta\epsilon\bar{\alpha}\mu\alpha$, $\mu\eta\bar{\iota}\mu\alpha$, $\chi\bar{\upsilon}\mu\alpha$.

Except κλιμα, κριμα, ἔρυμα, πλυμα, which sometimes shorten the penultimate.

27. A before β, γ, δ, ζ, κ, λ, μ, ν, π, ρ, σ, τ, φ, χ, is mostly short; as ἀλλὰ καὶ αἱ ἀφ' αἷ, κρατερὸν δ' ἐπὶ μύρον ἔτελλε. Hom. Il. α. 25.

1. Except polysyllables in *ᾱτος*, if *ε* or a vowel goes before; as *ἀνᾱτος*, *Ἀγαᾱτος*, *ἀπᾱτος*: except *ἱεᾱτος*. Likewise nouns in *ᾱτης*, whether gentiles proper, or the names of stones, are usually long; as *Ἀσιυτης*, *ἄχᾱτη*, *Ἐυᾱτη*, *Γαᾱτη*, &c. Also numerals in *ακωτης*.

[illegible]

3. A is common in ἀμα, Ἀρη, καρδία, εἶναι, καλός, κραχύν. More frequently short in ἅλας, ἅλιος, ἅλιστα, ἅγιος, prandium, ἅττα, βαλσαμὸν, δάπτειν, Ζῆνιν, ναυγίαι, ναυγίαι, αἶψα, ταπεινός, ἀπάλαμνος: and more frequently long in ἄρα, θᾶκος, φᾶρος.

4. In the nominative, α in Ἀπολλων is short; in other cases, common. Ἀντς in the nominative is common, in other cases long.

28. I before β, γ, δ, ζ, η, λ, μ, ν, π, σ, τ, ρ, χ, is short. But ι before or after ς is mostly long; as Βεῖθυ, μέγα, εὐδαρὲν, τῷ δαίμοντι στήχας ἀνδρῶν. Hom. Il. ε. 746.

1. Except nouns in *ιν*, *ιν*, *ιν*, *ιν*, *ιν*, which generally have their penultimate long; as *διν*, *νιν*, *Αφροδιτη*, *Θερσιτη*, *Αδελφειος*.

2. Also, is long in these: Ἀρχῆς, Ἀρχὴν, ἀρχὴν,
ἀκινάκης, ἀκόντιον, ἀμύσεις, ἀμφύσεις, Δίδω, δίδω, ἐντὶ,
Ἐλπίς, ἰστί, ἴδω, ἴδω, ἴδω, ἴκαρος, ἴλη, ἴλιγξ, ἴλιον,
ἴλις, ἴλιστος, ἴμερος, ἴον, ἴω, ἴναχοι, ἴσθλος, ἴσθμιος,
ἰχὺρ, Καμήϊος, κίκαμος, κίκυς, κίχρεον, κλίβανος, κλίμαξ,
κλίτης, κνίθη, κνίπος, κοῖσθαλος, κοῖτις, κοκκαῖμος, κυρτός,
λίμος, μαριόλ, Μοιριάτιον, παρθενοπίτις, πεδίον, πίδαξ,
πίδω, πῖλις, Πίστα, σάτιον, σελίον, σίγη, Σιδών, Σιλκός,
σίσιμφορον, σίσυφος, σίμος, σίφων, σκίτων, σμίλη, σμίλαξ,
στίθη, στίφος, τίτμος, τίθω, τίθων, τίμα, τίται, τίφω,
Φίμος, Φένω, Φίτω, χαλῖος, χελιδών, χίλιος, χίλος, χλιδή,
χίλος.

3. But in these is common: Ἀισχρῆς, Ἰβὼν, Ἰκελός,
 Ἰκίτης, Ἰκάνω, Ἰμάς, κικω, κοφῖνος, κστινός, λήος, μῆρικη,
 5 πινάξ.

πειναξ, σιδης, φιλος; and sometimes in λιδας, θαμιнос, λιπαρη, οπωρινός, δερβεινός.

4. Though ι before and after ρ is generally long, yet in the compounds and derivatives of τρις it is short, τρινακεις excepted. It is also short in εριφος, θριδαξ, κρινον, κρισις, κριτης, κριτος, τριδος, θριξ, τριχος, with their compounds. And in materials in ινος; as κεδρινος, μυρρινοι, &c.

29. Γ before β, δ, θ, κ, λ, ν, π, ρ, τ, φ, is short; but before γ, μ, σ, χ, mostly long: as Ὑμῖν μαρτυροῖσθε, ῥῶστέτε δ' ὀρκια πιστά. Hom. Il. γ. 280.

1. Except verbals in υπορη, υτης, υτος, υταρ, are long; as λυτρη, μνητης, κωνυτος, ῥυταρ: except a few in υτος sometimes short. Dissyllables in υλη, υνη, υνος, are long; except μυλη, γυνη, πωλυνος. Adverbs in υδον are long; as βοτρυδον, περδον, except ερδον.

2. These also have υ long: Ἀβυδος, ἀγκυρα, ἀλιμυρης, ἀτρακτιυλη. αὐτή, γεφυρα, Γευνιος, γυροι, ζυθοι, δυλακοι, τχυροι, κερυλη, κελυφος, κινυτοι, κογχυλιον, κορυρα, κοῦλη, κολυρα, κυρις, λαφυρον, λιπυρον, Λυδος, λυπη, μυλαγμα, μυρινα, μυροι, μυροι, μυλιαυ, οδυρα, οδυρος, οδονυρις, ορυτοι, πιτυροι, πηλημυρις, πυραμις, πυροι, ευτη, σκυτος, συριγξ, σφυρα, τυδεις, τυροι, τυρπαυ, υδος, χυλος, χιλυνη.

3. But υ in these is common: βοθυρος, βυθος, λεκρυφαλος, παπυρος, ρυτις, σιυνη, φυλος, σφονδυλειος, τορυνη, τρυφαυ, τυροι, υος; and sometimes in γυλοις, κορυνη, λαγυρος, ζυλον, φυταυ, φυταλια, φυταλμιος.

4. Though υ, before γ, μ, σ, χ, is generally long; yet it is short in the terminations υρος and υμαν; as in ἡδυμοις, διασυμω; and also in ὑσις, ζυσις, ἡλυσις, δυμαλις, δυμων, κυμιον, λυγος, λυσις, μαγμαρυγη, μυχοις, πυματο, τυσις, τυνη, χυσις; and υ is often short in δυσανος, ὑμνη, φυσις, and δυγατηρ.

Final Syllables.

30. Α, ι, υ, final are short: as μεσῶ, τετυφῶ, νῶ, ἱπποτῶ; μελῖ, τιθημῖ, τυπλουσῖ, ῥῖ; σῦ, δακεῦ, γλυκεῦ.

1. Except nouns in δα, θα, ρα, εα, ια, and polysyllables in αια; as κραίῃ; with ἑλῶα. Διῶ, ἴα, μία, πότινα, however, are short. So ἀγκυρά, ἄκανθα, γίφυρα, κεκυρα, ὄλυρα, σκολόπεινδρα, σφῖρα, τάνανα; compounds of μετρεῖ, as γεωμέτρεα; εα preceded by a diphthong, as πειρεῖ; except αὔρα, λαύρα, πλερεῖ, σαύρα.

2. Duals of the first declension; as κούσῃ.

3. Adjectives in α pure, and εα from masculines in ος; as δικαία, ἡμετέρα.

4. Nouns in εα from ευ; as δουλεία from δουλείω.

5. Oxytons of the first declension; as χρεά.

6. Accusatives in α from nouns in ευ, in the Attic dialect.

7. Vocatives from proper names in ας, as Αἰνεία, Πάλλα.

8. The Doric α, as α παγὰ for ἡ πηγὴ, βορέα for βορέου.

9. Adverbs in τι as usually long; in ιτι, short; as ἀνδρατί, Ἑλλενεσί.

10. Τῷ Doric for συ is long; and adverbs in υ, as μεταξῦ; but ἀντικρυ is common.

11. The names of letters; as ξι, μῦ; to which add κρι, γεῦ.

12. The paragoge in pronouns and adverbs; as ἐντοσι, νυί; except the dative plural; as σοῖσι.

13. The Attic ι for α, ι, or ο; as ταυτὶ for ταῦτα, εἰ for ὅτι, ταυτὶ for τοῦτο.

14. The imperfect and second aorist of verbs in υμι, as ἔφυν.

31. Α, ι, υ, final are short; as ἄν, ὦ Ἀἰών; παλῶν, ἐγὼν; σῶν.

1. Except that αν is long in circumflexed words, and in oxytons masculine; as πῶν, ἱτῶν.

2. These adverbs, ἀγαν, ἔκαν, λίαν, πῖραν; and the accusative of the first declension, whose nominative is long; as Αἰνείαν, Φιλίαν.

3. Ιν is long in words of two terminations; as δελφιν and δελφίς.

4. Ἡμῖν and ὑμῖν when circumflexed: τιν Doric for σοί. Περὶν is sometimes long in Homer.

5. Nouns in ιν, ινος, as ῥηγι, lengthen ιν final.

6. Ρν is long in words of two terminations; as φόρουν and φόρευν.

7. Accusatives from υς long; as ὀφρῦν, with ὦν; though υν, the enclitic is short; as τοῖνυν.

8. The imperfect and second aorist of verbs in υμι; as εἰδίκυν, ἔφυν.

32. Ας final is short, υς final long; as Νεκταῖς, αὐταῖς; ψιθυρ, πῦρ.

Except that γαρ and αὐταρ are sometimes long in Homer.

33. Ας, ις, υς, final are short; as λαμπράς, μεγαῖς, πολλῖς, ὄν, βαθύς.

1. Except that ας is long in the nominatives of participles; as τυφας; in all cases of the first declension; as Ἀντιας, ταμίαις, φίλαις, μούσαις, except the Doric accusative; as ὠμφαί; in plural accusatives in ας from the long α in the accusative singular of nouns; in ις; and in nouns in α-αντος; as Αἰας; with τάλας.

2. Also ις is long in words of two terminations; as δελφίς and δελφιν; in nouns in ις increasing long; as κημίς, ὄρνις, κίς, &c.

3. And υς is long in words of two terminations; as φόρευν and φόρευς; in monosyllables, as μῦς, with κῆμυς; oxytons making the genitive in ος pure; as πλεθύς; ιχθύς is common. And in verbs in υμι; as εἰδίκυνς, &c.

On Quantity in the Latin Language.

As the prosody of the Latin language is considered to form an essential part of a classical education, we shall, therefore, devote the more peculiar attention to this part of the subject. In the course of which some rules will be given on the quantity of syllables usually said to be long or short by authority; which, we believe, have never yet been collected by any writer, ancient or modern. Perhaps, therefore, in particular for this, and for such other reasons as the candour of impartial discernment shall discover, we shall not incur the censure of having been too sanguine, should we have indulged the hope of being enabled to offer the most complete system on Latin prosody that has hitherto been presented to the public.

GENERAL RULES.

A Vowel before a Vowel.

1. One vowel preceding another, in the same word, is short; as puer, egregiæ.

O Melibæe, Deus nobis hæc otia fecit.

Virg.

2. The same happens, though an b intervene; as nihil, æhenus, dêchifco.

De nihilo nihil, in nihilum nil posse reverti. Perf.

Note.—H is generally considered only as a note of aspiration or breathing: though some ancient grammarians considered H as a consonant, and ranked it with the semi-vowels. See Terentianus Maurus, de syll. 511.

1. Except

1. Except the *i* of *fi* is long, when it is not followed by *e* and *r*; as *fiam*, *fiēbam*, *fiat*.

Omnia jam fient, fieri quæ posse negabam. Ovid.

2. The *e* of the genitive and dative of the fifth declension, when it comes between double *i*, is long; as *faciēi*; but it is short in *spēi*, and long and short in *rei* and *līdei*.

Ventum erat ad Vēstæ quarta jam parte diēi. Hor.
Extingue flammæ; neve te diæ spēi. Seneca.
Ipſius rei rationem reddere poſſis. Lucret. *
Curtæ neſcio quid ſemper abeſt rei. Hor.
Ille vir laud magna cum re, ſed plenu' fidēi. Enn.
Unum pectus habent, fidēque immobile vinclum. Manil.

* *Lucretius furniſhes five examples of rei; Plautus two. Theſe caſes appear to have been anciently written both e-i and ei-i, which accounts for the variation in quantity.*

3. Genitives in *ius* have the *i* long in proſe, though in poetry it is common: as *unius* or *uniūs*, *illius* or *illiūs*: except the *i* of *alius*, which (formed by *cræſis* from *alius*) is always long, and the *i* of *alterius*, moſtly ſhort.

Nivibus, infandum! amiſſis, uniūs ob iram. Virg.
Partique meæ pæne totius inſtar erit. Ovid.
Tu potes alterius ſtudiis hærere Minervæ. Claud.
*Mox dum alterius * obligurrias bona.* Enn.

* *Alterius* is three times long in Terentianus; de ſyllab. 1072, de metr. 32; and 464.

4. The penultimate is long in *aurai*, *aulai*, and other antique genitives of the firſt declenſion, and in ſuch vocatives as *Pompei*, *Cai*; becauſe theſe were originally written with a double *i*; thus, *Pompeii*, *Caii*.

Ethereum ſenſum, atque aurai ſimplicis ignem. Virg.
Accipe Pompei, deductum carmen ab illo. Ovid.

5. In *ohe*, in *io* (whether interjection or proper name), and in *Diana*, the firſt ſyllable is common.

Oie! jam ſatis eſt, *ohe*, libelle! Mart.
Rurfus, io, magnos clamat tibi Roma triumphos. Mart.
Quaque ferebatur ductor Sidonius, io.—Conclamant. Sil. Ital.
Io, verſa caput, primos mugiverat annos. Propert.
Quæ tibi cauſa fugæ? quid io freta longa pererras? Ovid.
Expertæ eſt numen moriens utriuſque Dianæ. Mart.
Iuno, Veſta, Ceres, Diana, Minerva, Venus, Mars. Enn.

6. *Äer*, *Dius*, *ëheu*, have the firſt ſyllable long.

Proximus eſt äer illi levitate, locoque. Ovid.
Italides: quas ipſa decus ſibi dia Camilla. Virg.
Èheu, quid volui miſero mihi? floribus Auſtrum, &c. Virg.

7. In many Greek words a vowel is long, though immediately followed by another: as *Achæia*, *Achelous*, *Læertes*, *Læodice*, and other words compounded with *λαος*; *Latous*, *Enyo*, *Panchæia*, *Threicius*, *Täygetus*, *Trôas*, *Trôiūs*, *Galatïa*, &c.

Erubuit Mavors, averſaque riſit Enyo. Claud.

8. Thoſe words which are written in Greek with the diphthong *eu*, and in Latin with a ſingle *e* or *i*, have that *e* or *i* long; as *Æneas*, *Mufeum*, *Dariūs*, *Thalia*, *Clïo*, *Elegïa*, *Oræades*, &c.

Et panacæa potens, et Theſſala centauræa. Lucan.

9. Moſt adjectives in *eus*, formed from Greek proper names, have the *e* long; and it continues ſo, when reſolved into *ei*.

Oppida ſemoto Pelopeia marte vigerent. Claud.

Note.—1. Thoſe which contain a choree (") in the two ſyllables immediately preceding the penultimate, were more frequently formed, for the convenience of furniſhing a dactyl, with the penultimate ſhort; as *Hæſtoreus*, *Næſtoreus*, *Agênoreus*, *Antênoreus*, &c.

2. In imitation of the Greeks, we ſee in Statius, the adjective *Tiberëus*.

10. Names of towns, temples, or monuments in *ea*, *ia*, or *eum*, formed in the Greek manner, from the proper names of perſons, moſt commonly have the penultimate long; as *Laodicæa*, *Apamæa*, *Cæſaræa*, *Alexandria*, *Antiochiæa*, *Maulolæum*.

Terraſum mediis Apamææ mænia clara. Prif.

11. *Academia*, *Chorea*, *Platea*, *Malea*, have the penultimate common.

In Latium ſpretis Academïa migrat Athenis. Claud.
Atque Academïa celebratum nommè villam. Laur. Tul.
Puræ ſunt platææ, nihil ut medramibus obilit. Hor.
Aſpice! per bitidas plebs Romula tundur platæas. Prudent.

12. Greek genitives and accuſatives from nominatives in *eus* have the penultimate ſhort, according to the common dialect, long according to the Ionic.

Tyldes illa dies: illum tuncque tremuntque. Stat.
Ilionea petit dextrâ, levâque exercitum. Virg.

Of Diphthongs.

3. A diphthong is long; as *aurum*, *fœnus*, *audio*, *ætas*, *pænitet*, *Æneas*, *laus*, *Græus*, *Caius*, *Pompæius*, *Proculus*, &c.

Theſauros, ignotum argenti pondus et *auri.* Virg.

1. Except *præ*, immediately before a vowel in a compound word, is generally ſhort.

Nec tota tamen ille prior præeunte carina. Virg.

Note.—*Præ*, originally being *prai* or *præ*, by the eluſion of the latter vowel before a following one, the words became *præ'*-uſtis, *præ'*-eunt, &c. Statius, however, (*Theb.* 6. 519.) and Sidonius Apollinarius (*carm.* 23.) preferve the *æ* long.

2. A diphthong is once ſhort in a line of Virgil, out of compoſition; thus,

Infulæ Ionio in magno, quæ dira Celæno. Virg.

3. The *eu* of Greek proper names in *eus* (genitive *eor*) becomes a diphthong.

Parvo dilexit ſpatio Minoida Theſeus. Propert.
Conditus Inarimes æternâ mole Typhicæus. Lucan.

4. *Œi* is alſo a diphthong in Greek names, ſuch as *Orithyia*, *Ilthyia*, *Harpyia*, *Agyieus*, &c.

Orithyian amans fulvis amplectitur alis. Ovid.
Et patrio infantes Harpyias pellere regno. Virg.

A Vowel before two Conſonants.

4. A vowel is long by *poſition*, when it immediately precedes two conſonants, one or both of which being in the ſame word with it; as *arma*, *Errabât ſilvâ in magna*.

Pâſcere oportet oves, deductum dicere cæmen. Virg.

5. Alſo, a vowel is long by *poſition*, when it immediately precedes a double conſonant (*X* or *Z*), or the letter *J*; as *axis*, *patrizo*, *cujus*.

At nobis, Pæx alma, veni, ſpicamque teneto. Tibul.
It Sthenelus, qualem Mavortia vidit Amûzon. V. Flac.
Cauſa patrocini non bona pëjor erit. Ovid.

Note.—In reality the *J* or *I* makes a diphthong with the preceding vowel; viz. major, *pejor*, are from *mâi-or*, *pëi-or*;—and ſo in *Mâi-a*, *Mâi-us*, *Bâi-x*, *Troi-x*, *Ai-ax*, *ai-unt*, *Câi-eta*, *Câi-us*, and *Grâi-us*, diſſyllables. *Hujus* and *cujus* were, like *illius*, originally triſyllables, of which the firſt two, by ſynæreſis, coaleſced into one.

Except the compounds of *jugum*, which have the *i* ſhort before *j*; as *bijugus*, *quadrijugus*.

Martis equi bijuges, et magni currus Achillis. Virg.

Note.—The word which in England we pronounce *jugum*, is in reality *i-ûgum* or *yu-gum*, as the Germans at this day pronounce it. And in the meeting of two vowels, the former is tacitly elided, leaving the words *biûgus*, *quadriûgus*.

QUANTITY.

6. If the former of two words end in a short vowel, and the next begin with two consonants or a double letter, the vowel often remains short.

To poterat viri es pennis hebetar^s smaragdos. Ovid.
Jam medio apparuit fluctu memorat^s Zacynthus. Virg.

Note.—Virgil, however, who has adopted such licences as *sultus Hyacintho*, and *qui amant*, has lengthened the short syllable but in one line; ‘*herte citi ferrum, date tel^s, scandite muros.*’ Many of these vowels, which at the end of a word are found long before two consonants beginning a following word, are lengthened by the *cæsura*; as ‘*Ocell^s ipolia, et plures de pace triumphos.*’ Juven.

Of a Vowel before a Mute and a Liquid.

7. A vowel naturally short, followed by a mute and a liquid, is common, though always pronounced short in prose: as *āgrīs, pharētra*.

Natum ante ora patr^s, patr^semque obtruncat ad aras. Virg.
Nox tenebras profert, Phæbus fugat inde tenebras. Ovid.

Note.—1. To produce this kind of position, three things are requisite.

1. That the mute precede the liquid. 2. That the mute and the liquid be both in the following syllable; or otherwise this rule cannot take place; as in *ab-luo*, where the two consonants cannot be founded in the latter syllable. 3. That the vowel preceding the mute and liquid be short by nature. Hence the *a* in *ācris* and *mātris* is always long, because the *a* in *ācer* and *māter* is always long.

2. In Latin words, *l* and *r* are the only liquids preceded by a vowel and a mute; in Greek words, *l*, *r*, and also *m*, *n*, have the same effect as *Cyclopes*, ‘*Te-cneſſa*, *Da-phne*.’

3. *H* is not, neither in this, nor the foregoing rule, to be deemed a consonant. Joined with any of the consonants, it has not the power of lengthening a preceding short vowel; nor even with two consonants (*i. e.* a mute and a liquid,) in the next syllable; as

Illic Pall^sai proles veſuſ^s Philiippi Lucan.
Cernitur egregius lapis hic, cui nomen āchates. Prif.
Hic Pāph^sus myrtos, hic purpureas amēthyſſos. Ovid.
Arbor habet frondes, pabula ſemp^r hamus. Ovid.

Of Crasis, or Contraction.

8. Every syllable formed by the contraction of two syllables into one, is long; as *cōgo* for *cō-āgo*, the genitive *aliūs* for *aliūs*.

Tityre cōge pecus, tu poſt carecta latebas. Virg.
Obſcuræ tortis patres ambagibus errant. Ovid.

Note.—This is a rule of very extensive application. We are told that the ancients expreſſed a long ſyllable by a reduplication of the vowel; thus *vēnit* for the perfect *vēnit*. And it will be found that in many words the long ſyllable ariſes from the contraction of two vowels. Thus we write *tibicen* for *tibicēn*; *ambāges* for *ambāgēs*; *bigæ*, *trigæ*, for *bi-gigæ*, *tri-gigæ*; *jūnior* for *jūvenior*; *bōhus* for *bōvibus*; *it* for *it*; *mi* for *mihī*; and *mālo* for *māgis volo*.

Of Derivatives.

9. Derivatives uſually follow the quantity of their primitives; as *ānimus*, *ānima*, *ānimal*, *ānimalis*, *ānimofus*, *ānimare*: from *lēgo*; *lēgebam*, *lēgerem*, *lēgam*, &c.: but from *lēgi*; *lēgeram*, *lēgerim*, *lēgero*, &c. *tōtalis* from *tōtus*, and *tōtus* from *tōt*.

Nec tōta pars, homo terrāi quota tōtius unus. Lucret.

1. Except deſiderative verbs in *urio*, which have the *u* ſhort, although formed from the participle in *urus*, that has *u* long; as *nuptūrio* from *nuptūrus*.

2. Frequentative verbs, formed from the ſecond ſupine of the firſt conjugation, by changing *ātū* into *itō*, have the *i* ſhort; as *clamīto*, *volīto*.

Partūriunt montes, naſcetur ridiculus moſ. Hor.
Infelix ſua teſta ſuper volūtaerat aliſ. Virg.

3. There are other long derivatives formed from ſhort primitives, and ſhort derivatives formed from long primitives.

Note.—1. Of the former, the following is nearly an accurate liſt: *cōmo* from *cōma*; *fomes* and *fumentum* from *fōveo*; *hūmanus* from *hōmo*; *jūcundus* and *jūmentum* from *jōvo*; *mōbilis* from *mōveo*; *tēgula* from *tēgo*; *rēgula* from *rēgo*; *trīgula* from *trāho*; *vōmer* from *vōmo*; *vox-vōcis* from *vōco*; *deni* from *dēcein*; *ſuſpicio* from *ſuſpicio*; *ſecius* from *ſēcus*; *penuria* from *pēnus*; *hūmor* from *hūmus*; *jūgerum* from *jūguin*; *mācero* from *mācer*; *plāco* from *plāceo*.

2. Of the latter, the following are the principal; *āreſa*, *āriſſa* from *āreo*; *dicax* from *dico*; *diſertus* from *diſſero*; *dux-dūcis* from *dūco*; *fides* from *fido*; *frāgor* and *frāgilis* from *frāngo*; *lūcerna* from *lūceo*; *ditio* from *dis-ditis*; *mico* from *mica*; *nāto* from *nāto*; *noto* from *notu*; *pronūbus* and *pronūba* from *nūbo*; *quāſillus* from *quālus*; *roſa* from *ros-rōris*; *ſtābulis* from *ſtābam*; *sōpor* from *sōpio*; *ſtipula* and *ſtipulor* from *ſtipēs*; *sāgax* from *sāgio*; *vādum* from *vādo*; *āruſpex* from *āra*; *ambitus*, *ambitio*, *ambitioſus*, from *ambitu*.

3. Some of theſe anomalies have, perhaps, ariſen from the influence of *crasis* and *ſyncope*. Thus *mōbilis* from *mōveo*, may have been *mōvibilis*; *mōmentum*, *mōvimentum*; *mōtum*, *mōvitum*; *fōtum*, *fōvitum* from *fōveo*; *jūtum*, *jāvātum*; and *jūmentum*, *jūvamentum* from *jōvo*. Sometimes the derivative becomes ſhort by dropping one of the conſonants which rendered the word whence it is ſuppoſed to come, long by poſition; as *diſertus* from *diſſero*; *mānilla* from *mānima*; *vōlutum* from *vōlvo*; *sōlutum* from *sōlvo*; *tigillum* from *tignum*; *potui* from *poſſum*. When the primitive is neceſſarily ſhort, by one vowel's preceding another, as in *hēms*, the derivative ſometimes becomes long, by the inſertion of a conſonant, as in *hiberna*, *hiberno*, *hibernacula*. *Liquiſus* is ſuppoſed to have its ſiſt common (as it may be derived from the deponent *liquor*, or from the neuter *liqueo*;) on the following authority.

Crāſſaque conveniunt liquidiſ, et liquida crāſſis. Lucret.

Compound Words.

10. Compound words have the ſame quantity as the ſimple words from which they are formed; as *perlēgo* from *lēgo*; *perlēgi* from *lēgi*; *imprōbus* from *prōbus*; *perjurus* from *per* and *jus-jūris*.

11. The quantity of the primitive word is generally preſerved in the compound, notwithstanding the alteration of a vowel in the latter; thus *accīdo* from *cādo*, *accīdo* from *cædo*, *acquīro* from *quæro*, *inīquus*, *obliquus*, *antīquus* from *æquus*.

Multa renaſcentur, quæ jam cecidere, cādentque. Hor.

Except 1. The following are ſhort compounds from long primitives; *nihilum* from *hīlum*; *dejēro* and *pejēro* from *jūro*; *caufidicus*, *fatidicus*, *malēdicus*, *veridicus*, from *dīco*; *femisōpitus* from *sōpitus*; *cognitum* and *agnitum* from *nōtum*; *hōdie* from *hōc die*.

2. *Imbēcillus* from *bācillus* has the ſecond ſyllable long: *connūbium* from *nūbo* has the *u* common.

Porto meis, nullo dextram ſubeunte bācillo. Juven.
Imbēcillus, iners, ſi quid viſ? adde propino— Hor.
Connūbio jungam ſtabili, propiamque dicabo. Virg.
Hēctoris Andromache! Pyrriū' connūbia ſervas. Virg.

12. Prepoſitions, in compoſition, have generally the ſame quantity as out of it; thus *āmitto* and *dēduco* have the firſt long, becauſe *ā* and *dē*, as *a* final and monosyllabic *e* are long. *Āboleo* and *pērīmo* have the firſt ſhort, becauſe *āb* and *pēr*, as *b* and *r* final, are ſhort.

Expēdiam, primā repetens āb origine, ſamam. Virg.
Nec poterit ferrum, nec edax ābolere vetoitās. Ovid.

Note.—1. A prepoſition ending in a vowel, although out of compoſition it may be long, becomes ſhort by the firſt general rule, if followed by another vowel; as *dēſeculor*, *prōhibeo*. And if a ſhort prepoſition end in a conſonant, and be followed by another conſonant, it becomes long, by the ſecond general rule; as *ādmitto*, *pēcello*.

2. Sometimes the prepoſition, inſtead of becoming long by poſition, loſes its final conſonant, and remains ſhort; as *ōmitto*, *operio*.

Except 1. *Di* is ſhort in *dīrimo* and *diſertus*: as

Hanc Deus et melior litem natura dīremūt. Ovid.
Cauſas, inquis, agam Cicerone dīſertius ipſo. Mart.

2. *Rē* is short; as *rēmitto*, *rēpello*, *rēfero*. But *rē* (which here is supposed to be the ablative of *res*) is long in the impersonal verb *rēfert*, it *concerns*.

Propellit Boreas; æstus et unda rēfert. Ovid.
Præterea nec jam mutari pabula rēfert. Virg.

13. *Pro*, when used as a Greek preposition for *ante*, is short; as *prōpheta*, *prōlogus*, *prōpōntis*: but *pro*, a Latin preposition, is generally long; as *prōdo*, *proveho*, *prōmitto*.

Mist in has liquos longi Prōpōntis aquas. Ovid.
Quæ tam festâ diu, ut cesset prætere furem. Juv.

Except *prōfundus*, *prōfugio*, *prōfugus*, *prōnepos*, *prōneptis*, *prōfessus*, *prōfari*, *prōfiteor*, *prōfanus*, *prōfecto*, *prōcella*, *prōtervus*, and *prōpago*, signifying lineage; but *prōpago*, signifying a vine-stock, is long.

Note.—Notwithstanding such distinctions, *propago*, whose signification is always radically the same, may be considered among the doubtfuls; to which class *procumbo* is likewise added by some. But when the remarkable irregularity of *pro* is considered, without the slightest apparent reason to determine *why* it should be short in one word, long in another, and common in a third, it seems most probable, that it was in reality every where common, and that we should, doubtless, find it so, had we enough of the ancient poetry extant. The word being evidently borrowed from the Greek, in which it was written with an *O-micron*, we might for that reason expect to find it invariably short; but the Latin final *o* being in other cases more generally long, we might, on this account, as naturally expect to find *pro* usually made long, by those at least who were unacquainted with Greek. The poets seem to have availed themselves of this convenient ambiguity by making *pro* long or short, as proved most suitable to their purpose.

Of the final Vowels of first Words in Composition.

14. If the first member of a Latin compound word end in *A*, that vowel is long; as *trādo*, *trāno*, *quāre*, *quāpropter*, *quātenus*: but in Greek compounds the *A* is sometimes short; as *ādipfos*, sometimes long, as *Neāpolis*.

Quāre agite o proprios generatim discite cultus. Virg.
Extinguite sitim poma, cui nomen ādipfos. Prif.
Ambarum medio procera Neāpolis arcem. Avienus.

Except *eādem*, unless it be the ablative.

Non eādem arboribus pendet vindemia nostris. Virg.

15. If the first member of a compound word terminate in *e*, that vowel is short; as in the first syllables of *nēfas*, *nēfandus*, *nēque*, *trēdecim*, *trēcenti*; in the second of *valēdico*, *madēfacio*, *stupēfacio*, *trenēfacio*; and in the third of *hujuscēmōdi*, *euscēmōdi*.

Credebant hoc grande nēfas, et morte plandum. Juven.

Except *i*. The *E* is long in words compounded of *se* for *sex* or for *semi*; as *sedecim*, *semestris*, *semmodius*; (but in *selibra* it is short.)

Sēmihominis Caci facies, quam dira tegebat. Virg.
Argenti libram mitchas: facta selibra eit. Mart.

2. It is long also in *nēquis*, *nēquicquam*, *nēquam*, *nēquitia*, *nēquando*, *videlicet*, and *venēficus*.

Nēquicquam seros exercet noctua cantus. Virg.

3. *Liquefacio*, *tepefacio*, and *patefacio*, have the *e* of the second syllable chiefly short, though sometimes long; *rarefacio* and *rarefio* have the *e* generally long.

Sic mea perpetuis liquēfiunt pectora curis. Ovid.
Tibē liquēfactis, tendens ad sidera palmas. Ovid.
Et rarefuit calido micente vapore. Lucret.
Intremuit, motuque sinus patefecit aquarum. Ovid.
Atque patefecit, quas ante obsederat ater— Lucret.

Note.—Vossius observes that Virgil shortens the *e* in such words, and

that Lucretius and Catullus lengthen it, the former without cause. Indeed it is probable that in these words it was generally considered common.

16. If the first member of a compound word terminate in *i*, that vowel is short; as *bivium*, *trivium*, *triceps*, *siquidem*, *fatidicus*, *agricola*, *vatcinium*, *significo*, *architectus*, *dimeter*, *trimeter*, *Iphigenia*, &c.

Jane biceps! anni tacite labentis nrgo. Ovid.

1. Except those compounds in which the *i* is changed in declining; as *quidam*, *quivis*, *quilibet*, *quantivis*, *quantūcunque*, *tantidem*, *unicūque*, *eīdem*, *reipublicæ*, *qualiūcunque*.

Jure mihi videat quivis, ita te quoque amicum. Hor.

2. The final *i* is long in those compounds which may be separated without destroying the sense; as *ludi-magister*, or *ludi magister*; *parvipendo*, or *parvi pendo*; *lucrifacio*, or *lucri facio*; *siquis*, or *si quis*.

3. Those words which in joining undergo a crasis or syncope, are long; as *tibicen* for *tibiūcen*; *bigæ*, *trigæ*, &c. for *bijūgæ*, *trijūgæ*, &c.; *ilicet* for *ire licet*; *scilicet* for *scire licet*; but *tubicen*, which has suffered neither, is short by the general rule.

Illicet ignis edax summa ad cœlia vento. Virg.

4. *Idem* masculine is long; but in the neuter it is short. *Identidem* has the penultimate short.

Omnibus idem nimus, scelerata excedere terrâ. Virg.
Invitum qui servat, idem facit occidenti. Hor.
Qui sedens adversus identidem te. Catul.

5. The final *i* of the former compounding word, is long in *nimirum*, *ubique*, *utrobique*, *ibidem*.

Dixi equidem et dico. Captes astutus ubique. Hor.

6. As the *i* is common in *ubi*; so it is in *ubicunque* and *ubivis*.

Clamat: io matres audite ubicunque Latinæ. Virg.
Servor, ubicunque est: uni mea grudia servo? Ovid.

7. The compounds of *dies* have the final *i* of the first word long; as *bīdium*, *trīdium*, *meridies*, *prīdie*, *postīdie*.

Si solus tibi trīduo legatur. Mart.

Note.—1. *Prīdie* and *postīdie* are long by exception 3, being *priori die*, and *posteriori die*.

2. *Quotīdie* and *quotidianus* are said to have the *i* sometimes short; but this is not satisfactorily ascertained, since the lines adduced in proof may, by the figure *synizesis*, be differently measured: thus

*Conjugis in culpa flagravī quōtīdīānā.** Catul.

* Or *quōtīdī-yā-nā*. It must be confessed, however, that thus read the line is harsh, and is unnecessarily rendered spondaic.

3. *Trīginta*, *trīgēsimus*, *trīcēsimus*, and *trīceni*, are not considered as compound words, in which the *tri* is short, as it is in all the real compounds of *tris*, viz. *triceps*, *triplex*, *triformis*, *tricuspis*, *trīcenties*, &c. &c. for *trīginta* cannot with propriety be called a compound word, since *ginta* is only a termination. At all events the *tri* in *trīginta*, &c. is ever long.

17. If the first member of a compound word terminate in *o*, it is short; as *Argōnauta*, *Archōphylax*, *areōpagus*, *bibliothēca*, *philōsophus*, *sacrōsanctus*, *duōdecim*, *hōdie*.

Non nautas puto vos, sed Argōnautas. Mart.
Non dices hōdie, quorū hęc tam putida tandem— Hor.

1. Except words compounded with *intro*, *retro*, *contro*, and *quando*; as *intrōduco*, *intrōmitto*, *retrōcedo*, *contrōversus*, *quandōque*, &c.; but *quandōquidem* has the *o* short.

Ipsē retrōversus squalentia protulit ora. Ovid.

2. Also *aliōquin*, *utrōque*, *cæterōquin*, *utrōbique*; and

and the compounds of *quō*; as *quōmodo*, *quōcunque*, *quōminus*, *quōcirca*, *quōvis*, and *quōque* the adjective; but *quōque*, the particle, has the *o* short.

Mendosa est natura, aliōquā recta, velut si. Hor.

3. Those words which in Greek are written with an *o-mega*, have the *o* long; as *geōmetria*, *geōgraphia*, *minōtaurus*, *lagōpus*.

Si meus auritā gaudet logōpode Flaccus. Mart.

18. U and Y terminating the first member of a compound word, are short; as in *Tlirasylbulus*, *Eurypylus*, *Polypus*, *dūcenti*, *dūpondium*, *quadripes*, *centiplex*, *Trojūgena*, *cornūpetā*, *Polydorus*, *Polypheumus*, &c.

Nam fuit hoc vitiosus: in horā sæpe dūcentos— Hor.
Nam qualis quantūque cavo Polypheumus in antro. Virg.

Except *jūdico*, which in its first syllable is, by syncope, long.

Et sapit, et mecum facit, et Juve jūdicant, æquo. Hor.

Of the first Syllable of Diffyllabic Preterites.

19. Preterites of two syllables have the first long; as *vēni*, *vīdi*, *vīci*.

Vēnit summa dies, et ineluctabile tempus. Virg.

Except *bibi*, *tūli*, *dēdi*, *stēti*, *stīti*, *scīdi* from *scīdo*, (for *abscīdi* is long from *abscīdo*, and *abscīdi* short from *abscīdo*.) *fīdi* from *fīdo*, (for *fīdi* and *confīdi* from *fīdo* are long.)

Aut scīdit, et medias fecit sibi littora terras. Lucan.

Of the two first Syllables of Reduplicated Preterites.

20. Preterites doubling their first syllable, have that syllable and the following both short; as *tētīgi*, *pēpūli*, *pēpēri*, *didīci*, *tūtūdi*, *cēcīdi* from *cado*.

Si nēmīni fuerant tibi quatuor, Ælia, dentes. Mart.
Littora, quæ cornu pēpūlit Saturnus equino. Val. Flac.

Except *cēcīdi* from *cædo* has the second syllable long; and likewise those preterites, in which that syllable is followed by two consonants; as *fēfēlli*, *mōmōrdi*, *spōpōndi*.

Ebrius et petulans, qui nullum sorte cecīdit. Juven.
..... Vatum spōpōndit: nulla propter me sacro. Senec.
Quæ Deus ipse viris intermina fortibus spōpōndit. Prud.

Note.—From the authorities here quoted, it is evident that *spōpōndi* is the classic orthography, not *spōspōndi*, which would have the first syllable long by position, before *sp*, as we may invariably observe in compound words; as *rēspuo*, *rēspicio*, *rēspōdeo*, *rēspiro*, *rēspargo*, &c.

Of the first Syllable of Diffyllabic Supines.

21. Supines of two syllables, and the perfect participle formed from them, have the first syllable long; as *vīsum*, *mōtum*, *ēsum*, *stētum*, *vīsus*, *mōtus*, &c.

Terribiles vīsu formæ, letumque, laborque. Virg.
Quos ego — sed mōtos præstat componere fluētus. Virg.

1. Except the first syllable is short in *dātum*, *rātum*, *fātum*, *ītum*, *lītum*, *quītum*, *sītum*, *rūtum*, and *fūtum*, from the obsolete *fuo*, whence we have *fūturus*.

Cui dātus hærebam custos, cursūque regebam. Virg.

2. *Cītum* from *cio* of the second conjugation has the *i* short; but *cītum* from *cio* of the fourth conjugation has it long.

Corripuit sese, et teclis cītus extulit altis. Virg.
Unde ruunt toto concīta pericula mundo. Lucan.

3. *Statum* is common: hence we find *stāturus*, *constāturus*, *obstāturus*, *stāmen*, *stātus-a-um*, *stātus-ūs*,

præstītum, *statio*, *stātuo*, *stābilis*, *stābulum*, *stātor*, *stātim*, &c.: the former of which are said to come from *sto*, the latter from *stilo*.

Hic stātus in cælo multos permanit in annos. Ovid.
Damnavit multo stāturum sanguine Martem. Mart.
Infltor imperii, caupo famosus honorum. Claud.
Non præstata sibi præstat natura sed unus. Prop.
Constātura fuit Megalensis purpura centum. Mart.

Of the first Syllable of Polyfyllabic Preterites and Supines.

22. Preterites and supines of more than two syllables have the same quantity in their first syllable as the present; thus *vōcavi* and *vōcatum* have the first short, because the first of *vōco* is short: *clāmavi* and *clāmatum* have the first long, because the first of *clāmo* is long.

Si vōcat officium turbā cedente vehetur. Juven.
Induit, implevitque mero, disolvitque vōcavit. Virg.

Except *pōfui*, *pōsitum* from *pōno*; *gēnuī*, *gēnitum* from *gīgno*; *pōtūi* from *pollum*; *sōlutum*, *vōlutum* from *solvō* and *vōlvō*.

Sæcula? qui tanti talem gēnuere parentes. Virg.

Of the Penultimate of Polyfyllabic Supines.

23. Supines of more than two syllables, in *ātum*, *ētum*, and *ūtum*, lengthen the last syllable but one; as *amātum*, *delētum*, *minūtum*.

24. Supines in *itum*, from preterites in *ivi*, also have the penultimate long; as *cupīvi*, *cupītum*; *petīvi*, *petītum*; *quæsi*, *quæsitum*; *polīvi*, *polītum*; but the compounds of *eo*, *ambio* excepted, have the penultimate short.

25. Supines in *itum*, from any other preterites, shorten the penultimate; as *cubui*, *cubūtum*; *monui*, *monūtum*; *abolevi*, *abolūtum*; *agnovi*, *agnūtum*; *credidi*, *credītum*: *recensitum* of *recenseo* is long, on account of its origin from the obsolete *cenſio*, *cenſivi*.

Namque ferunt lætū Cyenum Phaëthontis amātū. Virg.
Delētus Volscorem acies, cecidisse Camillam. Virg.
Sustulit exūtas vinclis ad sidera palmas. Virg.
Sæpe lacessitus probris, gladiūque petitus. Claud.
Cedamus Phœbo, et moniti meliora sequamur. Virg.
Prisca recensitis evolvite sæcula fastis. Claud.

Of the Penultimate of Participles in RUS.

26. Participles in *rus* always lengthen the last syllable but one; as *amatūrus*, *habitūrus*, *lectūrus*, *auditūrus*.

Tarda venit, feris factūra nepotibus umbram. Virg.

Increment of Nouns.

Note.—1. If the genitive case singular do not contain a greater number of syllables than the nominative, that noun has no increment, as *penna*, *penus*, *caro*, *carnis*. But if the genitive contains more syllables than the nominative, the penultimate of the genitive is the increment; and whether that syllable be long or short, it preserves the same quantity in all the oblique cases singular and plural. If *bōbus* or *būbus* be an exception, we should recollect, it is so by syncope and crasis from *bōvibus*. Ausonius, contrary to the practice of better authors, has an example of *bōbus* short, as if it had been formed by simple syncope without crasis. See Auson. Epig. 62.

2. Nouns seldom have more than one increase in the singular: *iter*, *jecur*, (when its genitive is *jecinoris*), *supellex*, and the compounds of *caput*, ending in *ps*, have two increments. The dative and ablative of the third declension have two; of the aforementioned words, three increments. They are reckoned in the retrograde order, beginning with the penultimate, for the last syllable is never considered as an increment.

$i-ti-ne-ris$, $i-ti-ne-rī-bus$,
 $je-ci-no-ris$, $je-ci-no-rī-bus$,
 $supel-lec-ti-lis$, $supel-lec-ti-lī-bus$,
 $an-ci-pi-tis$, $an-ci-pi-ti-bus$.

QUANTITY.

Of the Increments of the Singular Number.

Of the first, second, fourth, and fifth Declensions.

27. In the first, fourth, and fifth declensions, there is no increment in the singular; except the antique increment of the first declension, by the resolution of the diphthong *æ* into *ai*, in which the *a* is long; as

Dives equam, dives piæiæ vestis et auri. Virg.

28. The increments of the second declension are short: as puëri, viri, fatûri, tenëri.

Opuëri! ne tanta animis affuecitate bella. Virg.

Except Iber, Ibëri, and its compounds Celtiber, Celtibëri, which lengthen the penultimate; as

Quique ferus movit Serorius exul Ibëros. Lucan.
Vir Celtibëris non tacende gentibus. Mart.

Increments of the third Declension.

29. Nouns in A shorten the genitive penultimate; as dogma-ätis.

Non quivis videt immodulata poemäta iudex. Hor.

30. Nouns in I, compounds of meli, shorten the genitive penultimate; as hydromeli, hydromelitis.

31. Nouns in O, increasing in inis, shorten the genitive penultimate; as cardo, cardinis; imago, imaginis.

32. Ënis and önis, from o, are long; as anio, anienis; sermo, fermönis.

1. Except gentiles in o generally shorten the increment; as Macedo, Macedönis; Saxo, Saxönis. To which add Lingönes, Seuönes, Tentönes, Vangiönes, Vascönes. Some lengthen the penultimate; as Sufessönes, Vettönes, Burgundiönes, Eburönes. Juvenal shortens Britones; Martial lengthens it.

2. Nouns in on, from the Greek *ων*, which sometimes drop the *n*, preserve in Latin the same quantity which they have in the original; as Agamemnon or Agamemno, Agamemnönis; Demiphon or Demipho, Demiphönis.

Sanguine placidus ventos, et virgine cæsa. Virg.
Hæc tum multiplici populos sermone replebat. Virg.
Non longinqua docent domito quod Sævone Tethys. Claud.
Qua nec terribiles Cimbri, nec Britönes unquam— Juven.
Quam veteres braceæ Britönes pauperis et quam— Mart.
Quo ferus injusto petiit Agamemnöna ferro— Ovid.

33. Nouns in EC lengthen the genitive penultimate; as halec-ëcis.

Halecem sed quam protinus ipsa voret. Mart.

34. Nouns in D shorten the genitive penultimate; as David, Davidis.

Erecto indulget Davidis origine lumen. Juven.

Note.—Ecclesiastical writers often lengthen the penultimate of David.

35. Masculines in AL shorten the genitive penultimate; as Hannibal-älis; fal-sälis (masculine or neuter).

36. Neuters in AL lengthen älis; as animal-älis.

Vela dabant læti, et spumas sällis ære ruebant. Virg.
Pronaque cum spectent animalia cætera terram. Ovid.

37. SOL lengthens sölis; and also Hebrew nouns in EL lengthen the genitive penultimate; as Daniel-ëlis.

Regia sölis erat sublimibus alta columnis. Ovid.

38. All other nouns in L shorten the genitive increment; as vigil-ilis, consul-ülis, exul-ülis.

Aut ursum, aut pugiles, his nam plebecula gaudet. Hor.

39. Nouns in EN shorten the genitive penultimate; as crinen-inis, flumen-inis.

Quodque magis mirum est, auctorem criminis hujus— Mart.

40. No certain rule can be given for the quantity of the increment of nouns ending in ON. Many lengthen the genitive penultimate; as Chiron, Demiphon, Agon, Helicon, Lacon, Sicyon, Solon, Simon: many shorten it; as Actæon, Agamemnon, Amazon, Jäson, Memnon, Philæmon, Orion, Sidon, Sindon: and Ægæon has the penultimate common.

Credit, et excludit sanos Helicöne potas. Hor.
Et velint absentem certatim Ælacöna clamant. Ovid.
Audiérat duros laxantem Ægæöna nexus. Stat.
Ægeröna suis inmania terga lacertis. Ovid.

41. All other nouns in N lengthen the genitive penultimate; thus Titan-änis, Siren-ënis, delphin-inis, Phorcyn-ÿnis.

Concitat iratus validos Tithönos in armis. Ovid.
Orpheus in sylvis, inter delphinas Arion. Virg.

42. Neuter nouns in AR lengthen the genitive in äris; as calcar-äris.

Seu spumantis equi foderet calcäribus arnos. Virg.

But these neuters shorten äris; bacchar, jubar, nectar-äris. To which add par-päris, and its compounds; as impar-impäris; dispar-dispäris, &c.; also hepar-ätis.

Pugnare päreo; succubere pæres. Mart.

43. But masculine nouns in AR shorten äris; as Cæsar-äris, Hamilcar-äris, lar-läris.

Ecce Dionæi processit Cæsäris astrum. Virg.

Except Car and Nar; as,

Laudibus immodicis Cäres in astra ferant. Mart.
Sulfureas posuit spiramina Näris ad undas. Enn.

44. Greek nouns in TER lengthen the increment; as crater-ëris, character-ëris, spinther-ëris; except æther-ëris.

Indulgent vino, et vertunt crateras ahenos. Virg.
Quæcumque illa levem fugiens fecit æthëra pennis. Virg.

45. Nouns in OR lengthen öris; as amor-öris; timor-öris.

1. Except neuter nouns; as marmor, æquor-öris.

2. Greek nouns in OR; as Hæctor, rhetor-öris.

3. Arbor-öris, and memor-memöris.

4. Ador forms adöris or adöris, whence adöreus in Virgil, Horace, and Claudian.

Inter spem curamque, timöres inter et iras. Hor.
Præterea fuit in tectis de marmore templum. Virg.
Ingemit et dulci frater cum Castore Pollux. Val. Flac.
Finiet, ante gravem quæ legerit arbore solem— Hor.
Mox ador, atque adöris de polline pulificum far. Aufon.
Emicat in nubes ardor adöris. Präf.

46. The following nouns lengthen the increment; fur-füris, ver-vëris, Recimer-Recimeris, Byzer-Byzëris, Ser-Sëris, Iber-Ibëris, (as well as Iber of the second declension.)

Velleraque ut foliis depectant tenuia Sëres. Virg.

47. Other nouns in R, not mentioned, shorten the penultimate; as aer, aëris; mulier, ëris; cadaver-ëris; iter, itinëris; verber, verbëris; vultur, üris; murmur, üris; femur, robur, jecur, ebur-öris; martyr-ÿris.

Si nigrum obscuro comprënderit æëra cornu. Virg.
Aspice, ventosi ceciderunt murmuris auræ. Virg.

48. Latin nouns in AS lengthen the increment; as pietas-ätis; Mæcenas-ätis; vas, väs, a vessel.

Insignem pietate virum tot adire labores. Virg.

QUANTITY.

Except anas, anātis ; mas, māris ; and vas, vādis, a fecurity.

Tyrtaeusque mūres animos in martia bella. Hor.

49. Greek nouns in AS shorten ādis, ātis, and ānis ; as Pallas, lampas, ādis ; artocreas, ātis ; Melas, ānis.

Iuliar montis equum divina Pallādis arte. Virg.

50. Nouns in ES shorten the increment ; as miles, milītis ; feges, segētis ; prāfes, præsīdis ; obfes, obsīdis ; Ceres, Cerēris ; pes, pēdis.

Metiri se quemque suo modulo ac pēde, v. rum est. Hor.

Except locuples, quies, manfues, ētis ; hæres, merces, ēdis : alfo Greek nouns which have ētis ; as lebes, Thales, tapes, magnes, ētis.

Afcanium furgentem, et spes hæc Nis Iuli. Virg.
Viginti fulvos operoso ex ære lebates. Ovid.

51. Nouns in IS shorten the increment ; as lapis, Phyllis, īdis ; cinis, ēris ; fanguis, īnis.

Immolat et pornam feclerato ex fanguine fumit. Virg.

1. Except glis, glīris, and vīres the plural of vis, which lengthen the increment.

Somnuculosos ille porrigit glīres. Mart.
Sic fatus validis ingentem vīribus haftam— Virg.

2. Latin nouns which have itis, as dis, dītis ; lis, lītis ; Quiris, Samnis, ītis ; but Charis, a Greek noun, has Charitis short.

Infqueris tamen hunc, et lite moraris iniqua. Hor.
Tres fuerant Charites, fed dum mea Letbia vixit— Aufon.

3. Crenis, Crenīdis ; Nefis, Nesīdis ; Pfophis, Pfo-
phīdis, lengthen the penultimate ; hut Pfophis shortens it once in Statius.

Sylvaque, quæ fixam pelago Nesīda coronat. Stat.
Æpytos idem arbor agros, et Pfofida celfam. Stat.
Ufque sub Orchomenon, Pfofidaque Cyllenemque. Ovid.

4. Greek nouns in is, which have alfo the termination in ; as Salamis, or Salamin-īnis.

Tithuris umbra tui, Teucer Salaminia patremque. Hor.

52. Nouns in OS lengthen the increment ; as nepos, ōtis ; flos, flōris ; os, ōris ; cuftos, cuftōdis ; rhinoceros, ōtis ; Tros, ōis ; héros, ōis.

Qui legitis flōres, et humi nafcentia fraga. Virg.
Egreffi optatā potantur Troes arenā. Virg.

Except bos, bōvis ; compos, impos, ōtis ; which increafe short.

Perpetui tergo bōvis, et luftralibus extis. Virg.

53. Nouns in US shorten the increment ; as lepus, corpus, ōris ; vellus, ēris ; tripus, ōdis.

Ut canis in vacuo lepōrem cum Gallicus arvo. Ovid.

1. Except thofe nouns which have udis, uris, or utis ; as incus, incūdis ; tellus, tellūris ; falus, falūtis. But thefe are fhort ; Ligūris, from Ligur or Ligus ; pecūdis, from the obfolete pecus ; and intercūtis, from intercus.

In medio : facri tripōdes viridesque corouæ— Virg.
Fas et fura fiunt : rivos deducere nulla— Virg.
Non egote Ligūrum ductor fortiffime bello— Virg.

2. Comparatives in us lengthen the genitive penultimate ; as melius, meliōris.

Perge, decet, forfan mīlēs meliōra fequentur. Virg.

54. Nouns in YS shorten the increment ŷdis and ŷdos, and lengthens ŷnis ; as chlamys, ŷdis or ŷdos ; Trachys, ŷnis.

In medio, chlamyde, et piētis confpectus in armis. Virg.
Herculeā Trachyne iube, fub imagine regis. Ovid.

55. Nouns in S, preceded by a confonant, shorten their increment ; as cœlebs, ihis ; ftips, ftīpis ; Lælaps, āpis ; Cecrops, Dolops, ōpis ; auceps, cūpis ; hiems, ėmis ; alfo anceps, biceps, cipītis, and fimilar compounds of caput, in which both increments are fhort.

Ad matres primo ancīpites, oculifque malignis— Virg.
Hic Dolūpum manus, hic fævus tendebat Achilles. Virg.

Except Cyclops, ōpis ; feps, fēpis ; gryps, ŷphis ; Cecrops, ōpis ; plebs, plēbis ; hydrops, ōpis ; and genitives long by pofition ; as excors, excordis ; pars, partis.

Fortunam, et mores antiquæ plēbis, et idem— Hor.
Antiphatae memores inmanifuetique Cyclops. Ovid.

56. Nouns in T shorten the penultimate of itis ; as caput, itis ; finciput, fincipītis ; occiput, occipītis.

Magna fuit quondam capītis reverentia cani. Ovid.

57. A noun in X fhortens the vowel before gis ; as harpax, āgis ; grex, grēgis ; aquilex, lēgis ; biturix, īgis ; Styx, ŷgis ; Allobrox, ōgis ; conjux, ūgis ; Phryx, ŷgis.

Quinque grēges illi balantum, quina redibant. Virg.
Ad Stjga Tanariā est aufus defcendere portā. Ovid.

Except lex, lēgis ; illex, exlex, lēgis ; rex, rēgis ; coceyx, ŷgis ; malfix, īgis ; and frūgis, from the obfolete frux.

Omnia fub lēges mors vocat atra fuas. Ovid.

58. A noun in EX fhortens ĩcis ; as vertex, ĩcis ; pontifex, ĩcis : vibex (rather vibix), ĩcis excepted.

Qualem virgineo demeffum pollice florem— Virg.

59. But EX having ecis, lengthens the increment ; as vervex, ėcis.

Vervēcum in patria, craffoque fub ære nafci. Juven.

Except nex, nēcis, vĕcis, and prēcis, wanting nominatives ; alfo fœnifex ; refex, ėcis ; and fupellex, ecūlis.

Quam nēcis artifices arte perire fuas. Ovid.

60. And all other nouns in X generally lengthen the increment ; thus nouns in ax ; as pax, pācis ; fornax, ācis.

Except abax, fmilax, Atrax, dropax, fax, Atax, climax, panax, opoponax, ftyrax, colax ; the compounds of phylax and corax ; as Arctophylax, Nomophylax, nycticorax, phalaecorax, ācis.

Fraternaque fidem pñcis petiūtque deditque. Ovid.
Dicite fides animæ tuque, optime vates. Virg.

61. Thus words in IX ; as radix, felix, cicatrix, nutrix, victrix, altrix, perdix, coturnix, pernix, lodix, ĩcis.

1. Except appendix, chœnix, coxendix, cilix, calix, fornix, filix, hiftrix, larix, pix, falix ; varix, ĩcis, and ftrix, ftrigis.

2. Nix, nĕvis ; malfix, ĩchis, a gum.

Ecce coturnices inter fua prælia vivunt. Ovid.
Et filicem curvis invifam pafcit aratris. Virg.
Et ftrigis inventæ per buffa jacentia plumæ. Propert.
Jam fatis terris nĕvis atque diræ. Hor.
Contritumque fimul cum mafliche confer anethum. Seren. Samon

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62. And words in **OX**; as *vox*, *vōcis*; *velox*, *ūcis*. Except *Cappadox*; *præcox*, *ōcis*.

Condimus et magna supremum <i>vōce</i> ciemus.	Virg.
Mancipis locuples, eget <i>æris Cappadici</i> rex.	Hor.

63. In **UX**; as *lux*, *lūcis*; *Pollux*, *lūcis*. Except *dux*, *crux*, *nux*, *trux*-*ūcis*.

Relitit <i>Æneas</i> , claraque in <i>lūce</i> refulsit.	Virg.
Confedere <i>diūces</i> , et vulgi stante corona.	Ovid.

64. In **YX**; as *bombyx*, *ŷcis*. Except *onyx*, *ŷchis*; *Eryx*, *ŷcis*; *calyx*, *ŷcis*; *Naryx*, *ŷcis*. But *Sandyx* and *Bebryx* have the increment common.

Nec <i>siqua Arabio</i> lucet <i>bombyce</i> puella.	Propert.
Illeque <i>plebeio</i> , vel sit <i>ŷudicis</i> amictu.	Propert.
Interdum <i>Libyo</i> fucatur <i>ŷudice</i> pinnæ.	Gratius.
<i>Bebrycis</i> et <i>Scythici</i> præul inclementia <i>ŷacri</i> .	Val. Flac.

Of the Increments of the Plural Number.

65. The plural increments, **A**, **E**, **O**, are long; as *musarum*, *ambabus*, *animabas*; *rerum*, *rebus*, *horum*, *quorum*, *regnorum*.

Tuque, <i>haurum</i> interpret <i>curarum</i> , et <i>conſcia</i> , <i>Juno</i> .	Virg.
Scilicet in nobis <i>rerum</i> natura novata est.	Ovid.
<i>Rebus</i> in angulis facile est contemnere vitam.	Mart.
Projicis? O <i>Latio</i> caput <i>horum</i> et causa <i>malorum</i> .	Virg.

66. The plural increments **I** and **U** are short; as *quibus*, *tribus*, *montibus*, *veribus*, *lactibus*.

Except *bubus* or *bobus*, which, on account of its contraction from *bovibus*, as already explained, is long.

Necte <i>tribus</i> nodis ternos, <i>Amarylli</i> , colores.	Virg.
Non <i>opibus</i> mentes hominum curaque levantur.	Tibul.
Pars in frustra fecant, <i>veribusque</i> trementia figunt.	Virg.
Cum <i>ŷaber</i> eduxit, <i>lactibus</i> demittit: at illud —	Ovid.
Et totum lustrat curvatis <i>arcibus</i> orbem.	Manil.
Et <i>Tiberis</i> nostris advena <i>bubus</i> erat.	Propert.

Increment of Verbs.

Note.—1. When any part of a verb exceeds, in the number of syllables, the second person singular of the indicative present, active, the excess is considered as the increment. As in nouns, the last syllable is never reckoned the increment; so also in verbs; and, therefore, when there is only one increase, it must be the penultimate.

2. Thus *amat*, *amant*, *ama*, *amem*, *amans*, containing, like *amas*, only two syllables, have no increment. *A-ma-mus*, *a-ma-tis*, *ŷe-tis*, *ŷci-res*, *da-mus*, have one increment, because they exceed, by one syllable, *amas*, *ŷes*, *ŷcis*, and *das*. *A-ma-ba-mus*, *a-ma-bi-mus*, have two increments, because they exceed *amas* by two syllables. *A-ma-ve-ri-tis* has three increments. *Audi-e-ba-mi-ni* has four, because it has four syllables more than *audis*. In determining the increments of deponent verbs, an active voice may be supposed; thus, *co-na-tur* has one increment; *co-na-ba-tur*, two; *co-na-re-mi-ni*, three; because *conas* of the fictitious active voice has but two syllables. Or their increments may also be regulated by other verbs of the same conjugation and number of syllables, which have an active voice.

67. **A** is long in the increments of verbs; as *ŷlabam*, *ŷtares*, *properamus*, *docebamur*, *audiebamini*.

Serius aut citius sedem <i>properamus</i> ad unam.	Ovid.
<i>Pugnabant</i> armis, quæ post <i>ŷabricaverat</i> usus.	Hor.
Et <i>cantare</i> pares, et respondere <i>parati</i> .	Virg.
<i>Contemplator</i> item, cum se <i>nux</i> plurima <i>ŷilvis</i> .	Virg.

Except that *do*, and its compounds of the first conjugation, have *a* short in their first increment; as *damus*, *dabunt*, *dare*; so *circundamus*, *venundabo*, &c. But

in any other increment *do*, like its compounds of the third conjugation, is long; as *dabamus*, *dederatis*, *circundabamus*, *credamus*.

Hic lacrymis vitam <i>damus</i> , et misereŷcimus ultro.	Virg.
<i>Taurino</i> quantum poŷŷent <i>circumdare</i> tergo.	Virg.
Nam quod <i>conŷilium</i> , aut quæ jam fortuna <i>dabatur</i> ?	Virg.

68. **E** is long in the increments of verbs; as *ŷlabam*, *rēbar*, *amēris*, *docerem*, *legērunt*, *amēmus*, *amarēmus*, *amaviŷētis*, *regēbat*, *audiēbar*, &c.

Sic equidem <i>ducēbam</i> animo, <i>rēbarque</i> futurum.	Virg.
Neu juvenis celebret multo ŷermone, <i>caedo</i> .	Tibul.

Except 1. **E** before **R** is short in the first increment of all the present and imperfect tenses of the third conjugation: as *legēres* or *legere*, the indicative present passive; *legēre*, the infinitive present active, and imperative passive; *legērem* and *legēre*, the imperfect subjunctive active and passive. But *rēris* and *rēre* are long; as *amarēris*, *amarēre*; *docerēris*, *docerēre*; *regerēris*, *regerēre*; *audirēris*, *audirēre*.

<i>Parēre</i> personis, <i>dicēre</i> de vitiis.	Mart.
Sic flendus <i>Peleus</i> , ŷi moreretur, erat.	Ovid.
Cum conŷternatis <i>diripērēris</i> equis.	Ovid.
Nollra, neque ad ŷedes victor <i>velerēre</i> .	Virg.

2. **Bēris** and **bēre** are every where short; as *amabēris*, *amabēre*; *monebēris*, *monebēre*: and among the ancients, *largibēris*, *xperibēre* of the fourth. Excepting where the *b* belongs to the termination of the present; as *ŷcribēris* and *ŷcribēre* of the future passive being long by the general rule.

<i>Sanguine Trojano</i> et <i>Rutulo dotatēre</i> , <i>virgo</i> .	Virg.
<i>ŷcribēris</i> <i>Vario</i> fortis, et hoŷtium—	Hor.

3. **E**, before *ram*, *rim*, *ro*, and the persons formed from them, is short; as *amavēram*, *amavērim*, *amavēro*; *monuēram*, *monuērim*, *monuēro*; *rexēram*, *rexērim*, *rexēro*; *ŷram*, *ŷuēram*; *potēro*, *potuēro*, &c.

<i>Vincere</i> , nec dabo <i>potēris</i> convellere ferro.	Virg.
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4. By *ŷystole*, the poets sometimes shorten *e* before *runt*; as

<i>Obŷupui ŷletēruntque</i> comæ, et vox <i>ŷaucibus</i> hæŷit.	Virg.
<i>Di tibi</i> divitiis <i>deŷerunt</i> , <i>artemque</i> fruendi.	Hor.

69. In every increment, (whether the first, second, third, or fourth,) **I** is short; as *amabimur*, *docebimini*, *regitur*, *regimus*, *audimini*, *audiebamini*.

<i>Mora tarda</i> mente cedat: ŷimul ite; <i>ŷequimini</i> .	Catul.
<i>Venimus</i> ; et <i>latos</i> indagine <i>cincimus</i> agros.	Ovid.

Note.—In ŷuch verbs of the fourth conjugation as have in the first person plural of their present and perfect indicative, the same words, in regard to ŷpelling, there is a diŷtinction by the quantity; the penultimate of the former being long, as *venimus*, *reperimus*; and that of the latter ŷhort, as *venimus*, *reperimus*.

Except 1. Theŷe have *i* long; *ŷimus*, *velimus*, *nolimus*, with the other persons coming from them and their compounds; as *ŷitis*, *velitis*, *nolitis*, *nolite*, *nolite*; *malimus*, *malitis*; *poŷŷimus*, *poŷŷitis*, &c.

Ne nimium <i>ŷimus</i> , ŷtultorum more, moleŷti.	Mart.
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2. **I** before *vi* in preterites is always long; as *petivi*, *quæŷivi*, *audiŷi*, and in its derivative persons; as *petiŷiŷti*, *quæŷiŷit*, *audiŷimus*, &c.

<i>Ceŷi</i> et ŷublato montem genitore <i>petivi</i> .	Virg.
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3. The first increment of the fourth conjugation is long; as *audimus*, *auditis*, *auditur*, *audito*, *audirem*, *ŷcimus*, *ŷcire*; and in *audiŷam*, as it is ŷometimes contracted;

tracted; and in *ibam* and *ibo*, from *eo*. But when a vowel follows, *i* is short by position, as *audiebam*.

<i>Nutritus teneris immulgens ubera labris.</i>	Virg.
<i>Lenibunt tacito vulnera nostra sinu.</i>	Propert.
<i>Tu ne cede malis; sed contra audientior uto.</i>	Virg.
<i>Jungimus hospitio dextras, et tota sulimus.</i>	Virg.
<i>Qui non edutis, furi fite fabulis.</i>	Plaut.

Note.—*I*mus in every preterite, and in that of the fourth conjugation also, is short; as *juvinimus*, *vidimus*, *fecimus*, *venimus*, *amavimus*, *adolevimus*, *peperimus*, *munivimus*.

4. *Rimus* and *ritis* in the subjunctive preterite are short.

Egerimus nostri; et nimium meminisse necesse est. Virg.

5. *Rimus* and *ritis* in the perfect future subjunctive are common.

<i>Quas oh res, ubi viderimus nil posse creari.</i>	Lucret.
<i>Nec mi aurum posco, nec mi pretium dederitis.</i>	Enn.
<i>Videritis stellas illic, ubi circulus axem.</i>	Ovid.
<i>Dein cum millia fecerimus.</i>	Catull.
<i>Oderimus magis in culpam pernasque creatos.</i>	Manil.
<i>Cum maris Ionii transferitis aquas.</i>	Ovid.

Note.—We have innumerable examples to prove that *rimis* and *ritis* in the perfect future subjunctive is common; but concerning the quantity of *rimus* and *ritis* in the preterite subjunctive, grammarians are not agreed. A difficulty in this investigation arises from the similarity of the two tenses; the latter having not unfrequently been mistaken for the former, and *vice versa*: since “the perfect of the potential seems to be both past-perfect contingent, and future-perfect contingent. The perfect future has also so great an affinity to the preterperfect potential, that often a word may, consistently with the sense, be supposed to belong to either. As these tenses are usually interpreted in English, there is a great resemblance in their structure, as well as in the ideas which they express. Both are composed of verbs in present time, the one a verb of present liberty, or the like, the other of present intention or obligation; of an infinitive denoting subsequent or dependent possession; and a participle significant of the perfection of the action denoted by the verb: thus, *I may have written, I shall have written.*” We find by A. Gellius, 18, 2, that it was a subject of dispute at Rome, whether the tense in *rim* ought to be considered as *past* or *future*, or both. Such disputes may, perhaps, have arisen from the accessory circumstances which are implied, besides the immediate action of the verb; in the same manner as, in English, two forms, precisely the same in their structure and reference, are characterised by certain grammarians under different times, *viz.* *I may write*, and *I shall write*, the former being named, from the accessory idea, a present, and the latter, from the depending action, a future, while, in reality, if we apply the same criterion to them, they are both present, or both future. Indeed it has been contended that the future had the termination *rim*, as well as *ro*; so that it is reckoned not improbable that both may originally have been but one tense, which had both a past and future reference. It is evident that this is a consideration by no means irrelevant, but indispensably necessary, before we can, with certainty, determine the quantity of *rimus* and *ritis* in the subjunctive preterite. In addition to the authorities for reckoning *rimus* and *ritis* common, there is likewise sufficient example from Horace, Martial, Ovid, Seneca, Tibullus, and Plautus, to consider *ris* of the future, at least as common; and this is an argument founded on the analogy of other tenses between the quantity of the final syllable of the second person singular, and the penultimate of the first and second persons plural, for considering the following *rimus* and *ritis* also common.—*Ris*, *rimus*, and *ritis*, are usually accounted short; but it is exceedingly probable that, whether referred to the preterite or perfect future, they still might be used as common.

70. *O*, in the increment of verbs, is always long; as *amatôte*, *facitôte*, *itôte*.

Cumquē loqui poterit, matrem facitôte salutet. Ovid.

71. *U*, in the increment of verbs, is short; as *sūmus*, *posūmus*, *volūmus*, *malūmus*.

Dicite, Pierides: non omnia posūmus onnes. Virg.

Note.—For *U* in the penultimate of the future in *rus*, see the rule.

SECTION II.—On the quantity of the penultimate and antepenultimate syllables, and on the quantity of such as are usually said to be long or short by authority.

Note.—It is very well known that the prosodial rules, hitherto extant, determine not the quantity of every syllable of the Latin language; but of such only as are more commonly ascertained from the circumstances of position, derivation, preterites, supines, increment, and final syllables. Consequently, in the greater number of instances, the inquiries of the student are at a stand until he can appeal to that observation, which would be more happily employed in confirming his previous acquisitions. And thus with but partial instead of complete information, he arrives at but mere intimation, the first stage of his progress, at the time when he unquestionably might achieve the second, the satisfactory and practical illustration of his previous attainments. If we depend on practice for the first principles of our knowledge, we lose its best and happiest effect. Practice will always evince its most prevalent efficacy, when its office is alone to rear the superstructure on the basis of regular system and theory, and not to attempt the casual and fortuitous task of laying a transitory foundation, and that too on a vacuum, the baseless texture of ignorance, not admitting that analogy and arrangement, that reciprocal and corroborative illustration, which so essentially aid the intellectual faculty with effectual and permanent impression. The part which follows is an attempt to supply this desideratum. It was obtained by four consecutive analyses of the language, in which every word and syllable passed under minute and decisive consideration. This investigation was undertaken in consequence of its being suspected, that since it is a general rule in the prosody of the Latin language, that a vowel before two consonants, &c. is long, that a law exists, directly the reverse of this, and of not less extensive influence; *viz.* that a vowel before a single consonant is short: though each of these general and very extensive rules, may have, in special cases, their exceptions. The result justified the expectation, and proved, that principally with the addition of another general rule, the prosodial system might become so comprehensive, as to include and provide for the whole language; and consequently, for all those syllables usually said to be long or short only by authority. The exceptions to this general principle are chiefly included in the rules for the penultimate and antepenultimate syllables. And though some of these have appeared in former treatises, yet from their enlargement, the addition of others, the general rule, and its more special exceptions, which have arisen from the repeated analysis we have undertaken, it will be easy to perceive, that we have in this part some claim to originality. In the preceding rules, and in such as shall follow on final syllables, in justice to the subject and our readers, we have felt it indispensably incumbent on us to avail ourselves of the valuable researches of preceding and contemporary prosodians. And the originality of this section places us under the obligation of devoting peculiar attention, especially to the demonstrative part, that every rule and exception, which we now first offer, might not appear to rest on our bare assertion, but on the only legitimate warrant, poetic sanction. And thus, perhaps, we have now the opportunity, for the first time, of offering the only complete collection or system which determines the quantity of every syllable, at least of pure and Augustan Latin, that has hitherto been presented to the public.

1. Masculine patronymics in *ades* or *ides* usually shorten the penultimate; as *Priamides*, *Atlantiades*.

Atque hic priamidem laniatum corpore toto. Virg. *Æn.* 6. 494.

1. Except those formed from nouns in *eus*; as *1* *Pelides*.

2. Also *2* *Amphiaraides*, *3* *Belides*, *4* *Japetionides*, *5* *Lycurgides*.

1. *Par sibi Pelides: nec inania Tartara sentit.* Ovid. *Met.* 12. 619.
2. *Amphiaraides Naupactoo Acheloo.* Ovid. *Fas.* 2. 43.
3. *Belidae nomen Palamedis et Iphelyta fama.* Virg. *Æn.* 2. 82.
4. *Japetionides Atlas fuit. Ultima tellus.* Ovid. *Met.* 4. 632.
5. *Quique Lycorgiden lethavit, et arbore natum.* Ovid. in *lb.* 505.

2. Patronymics and similar words in *ais*, *eis*, and *ois*, lengthen the penultimate; as *Achais*, *Ptolemais*, *Chryseis*, *Æneis*, *Minois*, and *Latois*.

Proetus Ægides, raptâ Minoidē, Dian. Ovid. *Met.* 8. 174.

Except *1* *Thebais* and *2* *Phocais*: *3* *Nereis* is common.

1. *Thr-*

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1. *Thebædis* jussis tua tempora frondibus ornant. O. id. Met. 6. 163.
 2. *Phœbis* effundit vastos ballista molares. Silius Ital. 1. 334.
 3. Et tibi præ invidia *Nerēdis* increpitant. Prop. 1. 26. 15.
 4. *Nerēi*, te vercor; tua fulmine scivior ira est. Ovid. Met. 13. 858.
3. Words ending in *acus*, *icus*, and *idus*, shorten the penultimate; as *Ægyptiācus*, *aromaticus*, *callidus*.

1. Quos *Ægyptiācos* semper tenuit ab ævo— Cale.
2. Idaliæ lucos, ubi mollis *amarūsus* illum— Virg. Æn. 1. 693.
3. Vatis *futūlicæ*, cecinit quæ prima fururos. Virg. Æn. 8. 340.
4. Utque suum laqueis, quos *callidus* abdidit anceps. Ovid.

1. Except *Merācus*, *opācus*, *amīcus*, *apricus*, *anticus*, *ficus*, *mendicus*, *posticus*, *pudicus*, *umbilicus*, *vīcus*.

2. Also *nīdus*, *sīdus*; *fīdus*, *infīdus*: but *perfidus* (from *per* and *fides*), follows the general rule.

1. Ah! pereat quicunque *merācus* repperit uvas. Prop. 2. 3. 27.
2. Continui montes, nisi dissolentur *opāca*. Hor. Epist. 1. 16.
3. Esse tibi magnus, Thelesine, videris *amicus*— Mart. 3. 40. 3.
4. Duceret *apricis* in collibus uva colorem. Virg. Ecl. 9. 49.
5. Et super *onticos* in frontis imagine crines— Mill.
6. Cum me *ficus* alit, cum pascat dulcibus uvis. Mart. 13. 49.
7. Nec *mendica* leat barbati prandia nudi— Mar. 14. 81.
8. Occipiti cæco, *posticæ* occurrite sinuæ. Pers. 1. 62.
9. Perdaci poterit tam frugi tamque *pudica*. Hor. b. 2. s. 5. 77.
10. Nec *umbilicus* quod decorus et cedro. Mart. 8. 61.
11. Et tua patricius culmina *vīcus* habet. Mart. 7. 72.
12. Ore serunt, dulcem *nīdis* immitibus escam. Virg. G. 4. 17.
13. Hoc metuens, celi menses et *sidera* serva. Virg. G. 1. 335.
14. Fortunata domus, modò sit tibi *fīdus amicus*. Prop. 3. 20. 9.
15. Dissimulare etiam sperasti, *perfidus* tantum. Virg. Æn. 4. 305.

4. Words ending in *imus* or *ymus*, shorten the penultimate; as *finitimus*, *maximus*, *thymus*, *fortissimus*.

Thus *animus*, *decimus*, *finus*, *ocimum*, *anonymus*, *callionymus*, and all adjectives and superlatives in *imus* shorten the penultimate.

1. Entelle heroum quondam *fortissimè* frustra. Virg. Æn. 5. 389.
2. Fervet opus, redolentque *thymo* fragrantia mella. Virg. G. 4. 169.

1. Except *binus*, *linus*, *minus*, *opimus*, *quadrīmus*, *simus*, *trīmus*.

2. And two superlatives, *īmus* and *prīmus*.

1. Tum vitulos, *bimò* curvans, jam cornua fronte. Virg. Georg.
2. *Linus* ut hic durefcit, et hæc ut cera liquefcit. Virg. Ecl. 8. 80.
3. Scribere si fas est imitantes turpia *minos*— Ovid. Trist. 2. 515.
4. Aut spoliis ego jam raptis laudabor *opimis*. Virg. Æn. 10. 449.
5. Deprome *quadrīmum* Sabinâ. Hor. b. 1. od. 9. 7.
6. Dum tenera attendent *simæ* virgulta capellæ. Virg. Ecl. 10. 7.
7. Quæ, velut latiss equa *trīma* campis— Hor. b. 3. od. 11. v. 9.

Note.—The quantity of the penultimate of *patrimus* and *matrimus* is undetermined: Facciolatus, the Italian lexicographer, says "lis est inter grammaticos de quantitate eorum penultimæ, quæ adhuc est sub judice, quia nihil certi afferri adhuc potuit."

5. Other vowels before final *mus* or *mum* are long; as *rāmus*, *rēmus*, *pōmum*, *dūmus*.

So *amōmum*, *cāmus*, *cardamōmum*, *cinnamōmum*, *dēmum*, *extrēmum*, *fūmus*, *grūmus*, *hāmus*, *postrēmum*, *prōmus*, *racēmum*, *suprēmum*, *volēmum*.

Sylvestris *raris* *sparsit* *labrusca* *racēmis*. Virg.

1. Except *atōmus*, *balsāmus*, *cinnāmus*, *dōmus*, *glōmus*, *hūmus*, *postūmus*, *thalāmus*, *tōmus*.

2. And words ending in *dromus*, from the Greek *δρόμος*; as *epidrōmus*, *hemerodrōmus*.

1. Parvarum ferie constant connexa *atōmorum*. An.
2. & 3. *Balsāma* qui semper, *cinnāma* semper olet. Mart.
4. Non unquam gravis ære *dēmum* mihi dextra redibat. Virg.
5. Ut vinosa *glōmos* furtivæ Pyrrhia lanæ— Hor.
6. Spargite *hūmum* foliis, inducite fontibus umbras. Virg.
7. Silvius, Albanum nomen, tua *postūma* proles. Virg.

8. Post ubi jam *thalāmis* se composuere, siletur. Virg.
9. Scriptura quanti conficit, et *tōmus* vilis. Mart.

6. A vowel before final *le*, *lis*, or *les*, is long; as *molē*, *annālis*, *mōles*.

So *ancile*, *bovile*, *būle*, *caprile*, *crināle*, *focāle*, *forāle*, *incile*, *mantēle*, *mantile*, *ovile*.

And *āles*, *anilis*, *aprilis*, *civilis*, *carduēlis*, *curūlis*, *crudelis*, *conjugalis*, *dotalis*, *exilis*, *fidēlis*, *herilis*, *miles*, *patruēlis*, *proles*, *quincūtilis*, *subtilis*, *sextilis*, &c. with many others.

1. It opportuno se *bovili* condidit. Phædr.
2. At qui umbrata gerunt *civili* tempora quercu. Virg.
3. Tota cohors. Rarus venit in cœnacula *noles*. Juven.

1. Except *verbal* nouns or adjectives; as *agilis*, *amabilis*, *facilis*, *insile*, *missilis*, *miscile*, *utilis*.

2. And all adjectives in *atilis*; as *aquatilis*, *fluvialilis*, *plicatilis*, *volatilis*.

3. Also *dapsilis*, *daçtylis*, *gracilis*, *humilis*. *indoles*, *parilis*, *similis*, *sterilis*, *suboles*.

1. Nec tibi delicie *faciles*, vulgataque tantum. Ovid.
2. Pistor agens telis, liquitque *volatile* ferrum. Virg.
3. *Dapsilis* exceptit dictis, Cereceremque ferentes. Falisc.
4. Hinc pedem si ceperimus, edere iterum *daçtylum*. Terent.
5. Et *gracilis* fructus effugit umbra rogos. Ovid.
6. Atque *humiles* habitare casas, et flegere cervos. Virg.
7. Quid pius Æneas tanta dabit *indole* dignum? Lucr.
8. — Et noctes *pariles* agitare diebus. Virg.
9. Stes capite obliquo, multum *similis* metuenti. Hor.
10. Hic, *sterilem* exiguis ne deferat humor arenam. Virg.
11. Denfor hinc *suboles*, hinc largi copia lactis. Virg.

7. Adjectives in *inus* derived from nouns signifying *trees*, *plants*, and *stones*; also from *adverbs* of time, or from substantives signifying the four seasons of the year, shorten the penultimate; as *faginus*, *hyacinthinus*, *adamantinus*, *craftinus*, *diutinus*, *perendinus*, *chimerinus*, *annotinus*, *hornotinus*: to which add *bombycinus*, *elephantinus*, which seem rather to refer to the silk and ivory, than to the animals themselves.

1. Truditur e sicco radix *oleagina* ligno. Virg.
2. Grandia tolluntur *crystallina*, maxima rursus. Juven.
3. *Myrrhina*, deinde adamas notissimus. Virg.
4. Et lux cum primum terris se *craftina* reddet. Juven.
5. Delicias et panniculus *bombycinus* urit.

- Except *repentinus*, *matutinus*, *vespertinus*.

1. Inque *repentinus* convivia verba tumultus. Ovid.
2. *Matutina* parum cautos jam frigora mordent. Hor.
3. Nec *vespertinus* circumgemit urfus ovile. Hor.

Note.—The penultimate of *malinus*, Ainsworth, as well as every English lexicographer, has, without any poetic authority, marked long. Facciolatus, however, gives it that quantity, which, as derived from *malus*, a tree, it certainly should have.

8. All other adjectives and words ending in *inus* lengthen the penultimate; as *caninus*, *binus*, *trinus*, *festinus*, *Latinus*, *mediastinus*.

Vix primos inopina quies laxaverat artus. Virg.

- Except *asinus*, *cominūs*, *dominūs*, *eminūs*, *facinus*, *sinus*, *terminus*.

1. Suadebat *Asino* fugere, ne posset capi. Phædr.
2. & 4. *Cominūs* ense ferit; jaculo cadit *eminūs* ipse. Ovid.
3. Tum caput ipsi aufert *domino*, truncumque relinquit. Virg.
5. Nondum Jubitian *facinus* mortale fugarat. Ovid.
6. Nunc tantum *sinus*, et statio malefida carinis. Virg.
7. Quicunque mundi *terminus* obstitit. Hor.

9. Other vowels before final *nus* and *num* are long; as *urbānus*, *plēnus*, *dōnum*, *mūnus*.

So *ahēnus*, *fānum*, *prōnus*, *prūnus*, *ferēnus*, *venēnum*,

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num, vānus, and many others; for the nouns and adjectives comprised by this rule are numerous.

Aut montāna sedet circum castella sub armis.

Virg.

Except galbānus, mānus, oceānus, platānus, typānus; ebēnus, gēnus, tēnus, Vēnus; ōnus, ōnus, tōnus.

1. Fuscus colores, Galbānus habet mores. Mart.
2. Et mānus in gremio languida facta jacet. Ovid.
3. Quid tantum oceāno properent se tingere soles. Virg.
4. Non sine natanti platāno, lentaque forore. Catul.
5. Hinc radios trivere rotis, hinc typāna plaustris. Virg.
6. Fert ebēnum, folis est thurea virga Sabæis. Virg.
7. Idne est verum? Imò, id gēnus est hominum pessimum. Ter.
8. Est quodam prodire tēnus, si non datur ultrā. Hor.
9. Sic Vēnus; at Veneris contrā sic filius ortus. Virg.
10. At bīna pars procerum tacitā libabit acerrā. Perlius.
11. Tu pueris curre, Parmeno obviā, atque his ōnera adjuta. Ter.
12. Omnibus auditur. Sōnus est, qui vivit in illā. Ovid.
13. Tædia dulcisōnis auferat illa tōnis. Cato.

10. Words ending in *ino* or *inor* shorten the penultimate; as *līno*, *fulmīno*, *termīno*.

So *sīno*, *inquīno*, *coinquīno*, *circīno*, *femīno*, *grandīno*, *germīno*, *emīnor*, *procrastīno*, *comperendīno*; the compounds of *cāno*, as *concīno*, and many others.

Nunc sūnte, et placitum læti componite fœdus. Virg.

Except *divīno*, *omnīno*, *propīno*, *supīno*; also *clīno*, and its compounds, as *acclīno*, *inclīno*, *proclīno*, *reclīno*.

1. Hæc divīnari, notitiamque tuli. Ovid.
2. Non impulit me, hæc nunc omnīno ut crederem. Terence.
3. Nemo propīnabit, Calliodore, tibi. Mart.
4. Gramen, et erecto currum temone supīnant. Stat.
5. Quare etiam, atque etiam paulum clīnore necesse. Lucret.
6. Inclīnat curius; et eandem circīnat auras. Ovid.

11. Other vowels before final *no* or *nor* are long; as *māno*, *exarēno*, *pōno*, *Jūno*.

So *plāno*, *trāno*, *ferēno*, *dōno*, *cōnor*, and several others.

Hæc te nos fragili dōnabimus ante cicutā. Virg.

Except *cāno*, *rēno*, *hōnor*, *sōno*, and *tōno*.

1. Sicelides Musæ, paullo majora cōnamus. Virg.
2. Sed juremus in hæc; simul imis faxa rēnarint. Hor.
3. Sed cum summus hōnor finito computet anno. Juven.
4. Te lyra pulsa manu, te carmina nostra sōnabunt. Ovid.
5. Cum tōnat, exanimis primo quoque murmuræ cæli— Juven.

12. A vowel before final *na* is long; as *lāna*, *vēna*, *spīna*, *nōna*, *Lūna*, *rāna*, *arvīna*, *carīna*.

Hic regina gravem gemmis auroque poposcit. Virg.

Except *advēna*, *buccīna*, *domīna*, *gēna*, *fiscīna*, *fœmīna*, *machīna*, *pagīna*, *farcīna*, *tibicīna*, *trutīna*.

1. Non tamen hospes eris, nec jam potes advēna dici. Mart.
2. Sed qui sermones? Quæ faxæ buccīna famæ? Juven.
3. Concurrent trepidæ comites, domīnæque recentem— Virg.
4. Pendentesque gēnas, et tales aspice rugas. Juven.
5. Pressæque flammeola rumpatur fiscīna caltha. Cel.
6. Fœmīna palantes agit, atque hæc agmina vertit? Virg.
7. Aut hæc in nostros fabricata est machīna muros. Virg.
8. Quam sibi quæ Vari præscripsit pagīna nomen. Virg.
9. Muli gravati farcīnis ibant duo. Phædr.
10. Ebria nos madidis rumpit tibicīna buccis. Mart.
11. Si volet, hac lege in trutīna ponetur eadem. Hor.

13. A vowel before final *ne*, *ni*, *nes*, *nis*, is long; as *māne*, *sēni*, *mānes*, *fīnis*.

So *bulbīne*, *anemōne*, *confīne*, *pēne*; *bīni*, *lucāni*, *antepilāni*, *quīni*, *septēni*, *octōni*, *novēni*, *dēni*, *vicīni*,

ducēni, and other numerals in *eni*; so *fūnis*, *acclīnis*, *inclīnis*, *inānis*, *commūnis*, *immūnis*, *commūnis*, *immūnis*, &c.

1. Et quæ mūdē refert, et quæ surgentibus astris. Virg.
2. Bis dēnas Italo texamus robore naves. Virg.
3. Quod vivis: cūnis, et mūnes et fabula fies. Perf.
4. O curas hominum! O quantum est in rebus būne! Perf.

Except *bēne*, *sīne*, *pēnes*, *cānis*, *cīnis*, *juvēnis*; and nouns derived from *μαῖνομαι*, as *hippomānes*, *trichomānes*.

1. Vivitur parvo bēne, cui patrum— Hor.
2. Mollia cum duris, sīne pondere habentia pondus. Ovid.
3. Me pēnes est unum vasti custodia mundi. Ovid.
4. Sic cūnis catulos similes, sic matribus hædos. Virg.
5. For cūnis, see verse 3. under the above rule.
6. Clamoris juvenem pater excitat; accipe certas. Juven.
7. Hippomōnes, quod sæpè malæ legere novercæ. Virg.

14. A vowel before final *nea*, *neo*, *nia*, *nio*, *nus*, and *nium*, is long; as *līnea*, *cāneo*, *mūnia*, *pūnio*, *favōnius*, *scrīnium*.

So *arānea*, *gāneo*, *declīneo*, *delīneo*, *līneo*, *cicōnia*, *insānia*, *Irōnia*, *colōnia*, *alcedōnia*, *lacīnia*, *querimōnia*, *delēnio*, *exinānio*, *fīnio*, *insānio*, *mūnio*, *confinium*, *patrimōnium*, *vadimōnium*, and many others.

1. In foribus laxos suspendit arānea cæsces. Virg.
2. Carpmus: dum manē novum, dum gramina cānent. Virg.
3. Sævit amor ferri, et scelerata insānia belli. Virg.
4. Oppida cæperunt mūnire, et ponere leges. Hor.
5. Primo restituent vere Favōnii. Hor.
6. Pullati proceres, differt vadimōnia prætor. Juven.

1. Except *castānea*, *tīnea*, *māneo*, *mīneo*, *mōneo*, *tēneo*.

2. Also *ignominia*, *vēnia*, *līnio*, *lānio*, *vēnio*.

1. Castāneæ molles, et pressi copia lactis. Virg.
2. Aut tīneas pascos taciturnus inertes. Hor.
3. Quæ finis? Aut quod me mūnet ripendium. Hor.
4. Inclinata mūnent in eandem prodita partem. Lucret.
5. Aliquid mūncat, ut illa, quæ te scire credas, nescias. Ter.
6. Utque viam tēneas, nulloque errore traharis. Ovid.
7. Multa gemens, ignominium, plagasque superbi. Virg.
8. Orantes vēniam, et templum clamore petebant. Virg.
9. Neve tua Medæ liniantur cæde sagittæ. Propert.
10. Quin lūnient mundum; tanta est discordia fratrum. Ovid.
11. Momento cita mors vēnit, aut victoria læta. Hor.

15. A vowel before final *do* is long; as *vādo*, *cēdo*, *for-mīdo*, *rōdo*, *testūdo*.

So *rādo*, *crēdo*, *alcēdo*, *dulcēdo*, *cupīdo*, *crepīdo*, *nōdo*, *cūdo*, *lūdo*, *altitūdo*, *beatitūdo*, and many others; for the nouns and verbs comprised by this rule are very numerous.

Possē putes illos sicco freta rūdere passu. Ovid.

Except *cādo*, *divīdo*, *trepīdo*; and *rūdo*, which is common; and *ēdo*, to eat; *ēdo*, to declare, publish, &c. (the preposition *ē* being long,) follows the above rule.

1. Multa renascentur, quæ jam cecidere, cādentque. Hor.
2. Divīdimus muros, et mænia pandimus urbis. Virg.
3. Cūm subitō trepidare intus præcordia sensi. Ovid.
4. Findor: ut Arcadiæ pecuaria rūdere credas. Perf.
5. Inclusumque cavo faxo, atque inlucta rudentum. Virg.
6. Ut verō est expulsa quies; furit ardor ēdendi. Ovid.

16. E before final *rus*, *ra*, *rum*, is short; as *mērus*, *hēdēra*, *cætērum*.

The nouns and adjectives comprised by this rule are numerous.

Ite domum saturæ, venit Hespīrus, ite capellæ. Virg.
Certum est, in sylvis, inter spelæa fœrarum. Virg.

1. Except

QUANTITY.

I. Except ¹austērus, ²galērus, ³plērusque, ⁴sērus, ⁵sevērus, ⁶vērus; ⁷pēra, ⁸cēra, and ⁹sincērus, from line cērâ.

2. And though of anthēra, cenothēra, statēra, there is no poetic function, they are long by derivation from ἀνθηρα, ἐνοθηρα, and σταθηρα, so panthēra (Virg. *Æn.* 8. 460.) from ἄνθρ.

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| 1. Qui volet <i>aufēros</i> arte fer'ire viros. | Prop. |
| 2. Bēna manu, volūsoque lupi de pelle <i>galēros</i> . | Virg. |
| 3. <i>Pīraque</i> differat, et prætens in tempus omittat. | Hor. |
| 4. <i>Sērus</i> in offensam retuleitque pedem. | Tibul. |
| 5. Cum sit triste habitu, vultuque et veste <i>sevērūm</i> . | Juven. |
| 6. <i>Vērūm</i> , quid facias? Ut homo est, ita morem geras. | Ter. |
| 7. <i>Pīras</i> imposuit Jupiter nobis duas. | Phædr. |
| 8. Līmus ut hīc duret, et hīc ut <i>cēra</i> liqueat. | Virg. |
| 9. Enīe recidendū; ne pars <i>hīcēra</i> trahatur. | Ovid. |

17. Other vowels before final ¹*rus*, ²*ra*, ³*rum*, are long ; as *cārus*, *mīrus*, *mōrus*, *mūrus* ; *hāra*, *spīra*, *ōra*, *natūra*, *lōrum*, &c.

So āra, tiāra, īra, līra, hōra, aurōra, lōra, manti-
cōra, prōra, captūra, figūra, censūra ; also the nouns,
adjectives, and participles in *rus*, &c. are very nu-
merous.

1. Exultans rorem latè dispèrgit *amārum*. Virg.
2. Vela legunt focii, et *prōras* ad littoia torquent. Virg.
3. Puniceo tingit pendentia *nōra* colore. Ovid.

1. Except ¹barbărus, ²canimărus, ³camŭrus, ⁴canthărus, ⁵clŭrus, ⁶hellebŭrus, ⁷nŭrus, ⁸opipărus, ⁹ovipărus, ¹⁰fpărus, ¹¹Tartărus, ¹²tŭrus.

2. Alfo ¹³anchōra, ¹⁴cithāra, ¹⁵mōra, ¹⁶purpūra,
¹⁷philŕra.

3. And the following in *rum*; ¹⁸fö^{rum}, ¹⁹suppär^{rum},
²⁰gär^{rum}, ²¹pär^{rum}.

4. Also the ²¹compounds of *vōro*, as *carnivōrus*, *omnivōrus*; those ending in ²¹*phōrus* and *phōra*, from *φῆω*, as *amphōra*, *canephōra*, *echphōra*, *phosphōrus*, *cistphōrus*, &c.; and the derivatives of *ἀργυρός*, as *hydrargyrum*, *lithargyrum*.

1. *Barbērus* hīc ego sum, quia non intelligor ulli. Ovid.
2. Sed tibi dimidio confictūris *Canonicūrs* ovo. Juven.
3. Pes etiam et *canioris* hirtæ fœ cornibus aures. Virg.
4. Et gravis attritū pendebat *canthūrs* ansā. Virg.
5. Doctū et Phœbi *chōrs*, et *Dianæ*. Hor.
6. Scillanque *hellebōrs*que graves, nigrumque bitumen. Virg.
7. Si qua tibi *nūrs* est, si qua est tibi filia, voces. Ovid.
8. Vino ornamentis *opipārs*que opōniis. Plaut.
9. Præpinguis teres, *ovipārs*que congestior alvo. Aufon.
10. Agrestisq̃ue manus armat *spūrs*: vertitur ipse. Virg.
11. *Tartāra* Panthoidem iterum Orco— Hor.
12. Proximus ut viridante *tūro* confederat herbæ. Virg.
13. *Auchūra* jam nostram non tenet ulla ratem. Ovid.
14. Non studio *cithāræ*, nec Musæ deditus 'ulī. Hor.
15. Troja cadet; sed erit nostri *mīra* longa laboris. Ovid.
16. Per hoc inane *purpūræ* decus precor. Hor.
17. Duplicent nexæ *philīræ* coronæ. Hor.
18. Infanumque *fīrum*, aut populi tabularia vidit. Virg.
19. *Suppūrs* nudatos cingunt angusta lacertos. Lucret.
20. Præfuit cella, *gūro* de fuccis piscis Iberi. Hor.
21. Matutina *pārūm* cautos jam frigora mordent. Hor.
22. Mittre *carnivōrs* præberi pabula mandat. An.
23. *Phosphōre* redde diem; quid gaudia nostra moraris? Mart.
24. *Anphōra* non meruit nam pretiosa mori. Mart.

18. E before final *ro* or *ror* is short; as *fěro*, *gěro*, *těro*.

So tempěro, aspěro, blatěro, cætěro, capěro, celěro, confiděro, desiděro, ſcelěro, propěro, sěro (to ſow), quěror, &c.

Verùm, quid facias? ut homo est, ita morem gēras. Ter.

Except ¹spēro; ²affevēro and ³persevēro from se-

vērus, and the adverb ⁴sēro from tērus; for sēro, to sow, is short.

1. *Spēret* idem, fudet multū frustrāque laboret. Hor.
2. *Profitetur*, jurabit, *affēnērat*. Scāz.
3. Poſt manes tumultūque *perſeueret*. M r.
4. Verūm. Age modō hodie: *ſerō* ac nequidquam voles. Ter.

19. Other vowels before final *ro* or *ror* are long ; as *vāro*, *spīro*, *ōro*, *ūro*.

So liro, tîro, inquîro, acquîro, conquîro, plôro,
labôro, auctôro, ignôro, cûro, figûro, lûror, dûro,
and many others.

Delicias et panniculus bombycinus *arrit.* Juven.

1. Except ¹ăro, ²căro, ³fűro, ⁴lilăro, ⁵infőro, ⁶mőror, ⁷păro, ⁸fatűro, ⁹vőro.

2. Also the derivatives from genitives increasing short in *ōris* or *ūris*; as *decōro*, *murmūro*, from *decus-ōris*, *murmur-ūris*.

So *memōro* from *memor-ōris*; *corpōror* from *corpus-ōris*; *robōro* from *robust-ōris*; *exaugūro* from *augur-ūris*; *fulgūro* from *fulgur-ūris*; *expectōro* from *pectus-ōris*.

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|-----|--|--------|
| 1. | <i>Littus arant, Rutulosque exercent vomere colles.</i> | Virg. |
| 2. | <i>Sed malè viva curo est. Lambendo mater in artus—</i> | Ovid. |
| 3. | <i>Quid fîris? Aut quonam nostri tibi cura recessit.</i> | Virg. |
| 4. | <i>Hos ubi facundo tua vox hilâverat ore.</i> | Ovid. |
| 5. | <i>Licetne infîrare, si incomitari non licet?</i> | Plaut. |
| 6. | <i>Quid vitam mûor infivam, Pallante perempto.</i> | Virg. |
| 7. | <i>Umbras, et cælo diffundere signa pâraba.</i> | Hor. |
| 8. | <i>Qua fûrât Calabris culta Gæcis aquis?</i> | Mart. |
| 9. | <i>Optima sylvarum interea, pelagique vorabit.</i> | Juven. |
| 10. | <i>Et validas augeat vires, et robôrât istum.</i> | Lucræ. |

20. Words ending in ¹atus, ²etus, ³otus, ⁴utus, lengthen the penultimate; as probātus, cētus, tōtus, tūtus.

So grātus, facētus, bolētus, pōtus, agrōtus, argūtus, altūtus, brūtus, hirsūtus, mūtus, and many others; also participles in *ātus*, *ētus*, *ōtus*, and *ūtus*, as mandātus, decrētus, nōtus, minūtus, metūtus, cōstitūtus, volūtus, &c.

1. O *fortunātos* nimium, sua si bona norint ! Virg.
 2. Tu rem impeditam et perditam restituas ? hem ! quo } Ter.
 fractus fum. }
 3. Facile omnes, cum valemus, *recta* confilia, *ægrois* } Ter.
 damus. }
 4. *Tuta* manent ; mediis Tanaïs fumavit in undis. Ovid.

1. Except ¹cātus, ²lātus-ēris, ³stātus-ūs; ⁴impētus, ⁵mētus, ⁶vētus; and ⁷antidōtus.

2. ⁸Venētus is short by derivation from Venētix; ⁹quōtus from quōt; ¹⁰tōtus (so great), from tōt, for tōtus is long; and ¹¹arbūtus from arbor-arbōris.

3. Of *dicrotūm*, and *automātus* from *automāton*, there is no poetic authority.

4. Except also the plural genitives of nouns ending in *ma-mătis*; as *poemătum*.

5. And the participles *dātus*, *rātus*, *sātus*, *stātus*; for which see the rule concerning dissyllabic supines.

1. Me plus sapere quàm vos, dederim vobis consilium cūm. Plaut.
2. Impulit in lētus, et venti, velut agmine factō— Virg.
3. Et enim verò quoniam formam cepi huius in me et statum. Plaut.
4. Æquora; sic illam fert impētus ipse volentem. Virg.
5. Necdum est ille dolor, sed jam mētus incubat amens. Lucan.
6. Et vètera oblitis iura referre foris. Propert.
7. Et vendicaret falsò antitidum nomine. Phædr.
8. Sic Veniūs stagnante Pado, fuscòque Britannus— Lucan.
9. & IO. Nec tōta pars homo terrai, quita tōtus unus. Lucret.
11. Inferit verò ex factu nuci arbutus horrida. Virg.

21. Words ending in *itus* lengthen the penultimate; as
aurītus, crinītus, invitū, perītus.

eco, nunc omnem *auritum* populum. Plaut.

1. Except

QUANTITY.

1. Except ¹anhelitus, ²fervitus, ³spiritus, and ⁴sufpiritus.

2. Also ⁵all adverbs in *itus*; as *humanitus*, *penitus*.

3. ⁶Blütum is not derived from the termination *itus*, but from *βλῡτον*, and therefore shortens the penultimate.

4. Also polysyllabic participles in *itus*, not derived from preterites in *ivi*; as *habitus*, *exercitus*-a-um, and nouns derived from them; as *habitus-ūs*, and *exercitus-ūs*.

5. And the participles from the verb *eo*, and its compounds; as *transitus*-a-um, and their derivatives; as *transitus-ūs*; the participle *ambitus* is, however, long, and the noun *ambitus-ūs* short.

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| 1. & 4. Simul enunciato <i>suspiritūs</i> . Vix fuffero, hercle, <i>anhelitum</i> . | } Plaut. |
| 2. Apud me iusta et clemens fuerit <i>servitus</i> . | |
| 3. Dum memor ipse mei, dum <i>spiritus</i> hos reget artus. | |
| 5. Insequor, et causas <i>penitus</i> tentare latentes. | |
| 6. Apponunt rumicem, brassicam, betam, <i>blütum</i> . | |

For the 4th and 5th exceptions, see the rules for polysyllabic supines.

22. A vowel before final ¹men, ²mens, ³mentum, is long; as *levāmen*, *clēmens*, *āmentum*.

So *acūmen*, *crīmen*, *flāmen*, *flūmen*, *grāmen*, *jurgāmen*, *volūmen*, *argūmentum*, *jūmentum*, *atrāmentum*, and many others; the nouns comprised by this rule being numerous.

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| 1. <i>Flūminibus</i> salices, crassique paludibus alni. | Virg. |
| 2. Ego hanc <i>clēmētem</i> vitam, urbanum, atque otium. | Ter. |
| 3. <i>Strāmenta</i> defunt. Tollere hæc aranea. | Phædr. |

1. Except ¹tāmen, ²colūmen, ³hūmen, ⁴clémentum.

2. Also ⁵alimentum, ⁶docūmen or *documentum*, ⁷emolūmentum, ⁸monimentum or *monumentum*, ⁹regimen, ¹⁰specimen, ¹¹tegimen or *tegumen* and *integumentum*.

3. And such verbs as *frēmo*, *gēmo*, &c. will naturally shorten the penultimate of *frēmens*, *gēmens*, &c.

Note.—The irregularity of such words as *monimentum*, *documentum*, &c. has been considered as arising from the supine of the second or third conjugation; which originally, before the effect of syncope, is supposed to have generally been in *it* *nt*; as *moneo*, *monitum*, *monimentum*; *doceo*, or *dokeo*, *dokitum*, and by syncope *dok'-tum* or *doctum*; whence *dokimentum* or *documentum*, &c. But if these verbal nouns were primitively deducible from their supines, many of them must have subsequently assumed the characteristic of the infinitive present, as the *g* of *regimen* and *tegimen* will testify. See Salmon's *Stemmata Latinitatis* on the terminations *men* and *mentum*.

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| 1. Sed <i>tāmen</i> iidem olim curru succedere fueti. | Virg. |
| 2. Bone custos, salve; <i>colūmen</i> verò familiæ. | Ter. |
| 3. Vulgus <i>Hūmen</i> <i>Hūmenæ</i> vocat, fugit ille vocantes. | Ovid. |
| 4. Doctores, <i>elēmenta</i> velint ut discere prima. | Hor. |
| 5. Atque ipsæ vitæ sunt <i>alimenta</i> vices. | Ovid. |
| 6. Et <i>docūmenta</i> damus, qua simus origine nati. | Ovid. |
| 7. Nullus in urbe locus, nulla <i>emolūmenta</i> laborum. | Juven. |
| 8. Hic dabat, hæredes <i>monimentum</i> ne sequeretur. | Hor. |
| 9. In quo consilium vitæ, <i>regimenque</i> locatum est. | Lucret. |
| 10. Hocce etiam in primis <i>specimen</i> verum esse videtur. | Lucret. |
| 11. Istæ ego mihi semper habui ætati <i>tegimentum</i> meæ. | Plaut. |

23. A vowel before final ¹ma, ²mes, ³mis, is long; as *hāma*, *līmes*, *sublīmīs*.

So *agēma*, *dāma*, *fāma*, *plūma*, *poēma*, *rīma*, *rūma*, *sīma*, *sqūama*, *spūma*, *strūma*, *fōmes*, *trāmes*, *illimis*, *cōmis*, *sēmis*, *deplūmis*, *decirēmīs*, *quadrirēmīs*, *quīquerēmīs*, *infāmīs*, and many others in each of these terminations.

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| 1. Cum canibus timidæ venient ad pocula <i>dūmæ</i> . | Virg. |
| 2. Excitat invalidas admoto <i>fōmite</i> flammæ. | Lucan. |
| 3. <i>Sublīmes</i> in equis redeunt, pacemque reportant. | Virg. |

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1. Except ¹cōma, ²cōmes, ³cucūmis, ⁴fāmes, ⁵incolūmis, ⁶lacrūma, ⁷nīmīs, ⁸pyrāmīs.

2. Also the ⁹derivatives¹⁰ of *animus* and *decimus*; as *anīma*, *exanīmīs*, *decīma* or *decūma*.

3. ¹¹Dynāmis and ¹²endrōmis have their penultimate regulated by the Greek short *α* and *ο*; as *δύναμις*, *ἐνδρόμις*.

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| 1. <i>Cūmuntur</i> nostræ, matre jubente, <i>cōmæ</i> . | Ovid. |
| 2. Jamque <i>cōmes</i> semper magnorum prima malorum. | } Lucan. |
| 4. <i>Sæva fāmes</i> aderat: nulloque obfessus ab hoste. | |
| 3. <i>Caruleus cucūmis</i> , tumidoque cucurbita ventre. | Propert. |
| 5. Fecit; et <i>incolūmis</i> lator quod vivit in urbe. | Hor. |
| 6. Cogat et invitam <i>lacrūmas</i> ficcare cadentes. | Propert. |
| 7. Fortuna multis dat <i>nīmīs</i> , fati nulli. | Mart. |
| 8. Non mihi <i>pyrāmidum</i> tumulis evulsus Amasis. | Lucan. |
| 9. Tantūm <i>anīmas</i> , nobis <i>anīmum</i> quoque; mutuus ut nos. | Juven. |
| 10. Tibi propino <i>decūma</i> fonte: tibi cutē unde, si sapi. | Plaut. |
| 11. <i>Dynāmin</i> domi habent maxumam. | Plaut. |
| 12. Dona peregrinam mittimus <i>endrōmida</i> . | Mart. |

Note.—Ainsworth refers to Plaut. *Trinum*. 3. 3. 15. for *colūmis*. Taubmanni edit. anno 1621, has "Columen te filtere illi, et detraxe autement." The editions of Lambinus and Camerarius have also *colūmen*, according to the most ancient MSS. and editions. Facciolatus considers *colūmis* to be of doubtful authority: it cannot, therefore, be admitted as an exception to this rule. For *columen*, see rule 22, No. 2.

24. I or Y, or a vowel derived from the short increment of the genitive, before final *mo* or *mor*, is short; as *anīmo*, *æstīmo*, *decīmo*, *lacrūmo*, and *hiēmo* from *hiems-ēmis*.

Quo redit ad fastos, et virtutem *æstīmet* annis. Hor.

Except ¹līmo and ²rīmor.

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| 1. <i>Līmat</i> non odio obscuro merfuoque venenant. | Hor. |
| 2. Dulcibus in stagnis <i>rīmantur</i> prata Cæsitrī. | Virg. |

25. Other vowels before final *mo* or *mor* are long; as *clāmo*, *nēmo*, *prōmo*, *sūmo*.

So *fāmo*, *sqūāmo*, *tēmo*, *dēmo*, *postrēmo*, *fūmo*, *irrūmo*, *spūmo*, *rūmor*, &c.

Excuit et longe lapsum *tēmone* relinquit. Virg.

Except ¹āmo, ²autūmo, ³crēmo, ⁴dōmo, ⁵ēmo, ⁶frēmo, ⁷gēmo, ⁸hōmo, ⁹prēmo, ¹⁰trēmo, ¹¹tūmor, ¹²vōmo.

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| 1. Votum in <i>āmante</i> novum; vellem, quod <i>āmamus</i> abesset. | Ovid. |
| 2. Neque se id pigere, et deinde facturum <i>autūmat</i> . | Ter. |
| 3. Atque omnem ornatum, flammâ crepitante, <i>crēmari</i> . | Virg. |
| 4. Non anni <i>dūmure</i> decem, non mille carinæ. | Virg. |
| 5. Si quis <i>ēmat</i> citharas, emptas comportet in unum. | Hor. |
| 6. Post tergum nodis, <i>frēmīt</i> horridus ore cruento. | Virg. |
| 7. Parte flagellari <i>gēnuūt</i> sua rebora caudæ. | Ovid. |
| 8. <i>Hōmo</i> sum; humani nihil à me alienum puto. | Ter. |
| 9. Ignosce; <i>prēmīt</i> ille graves interritus iras. | Lucan. |
| 10. Tempestas concussa <i>trēmīt</i> , <i>frēmītusque</i> moventur. | Lucret. |
| 11. Custodum et nullo septa <i>tīmōre</i> , placet. | Propert. |
| 12. Mane salutantum totis <i>vōmit</i> ædibus undam. | Virg. |

Note.—*Comō-ere* follows the general rule; but *cōmo-āre*, a verb seldom used, shortens the penultimate: both are derived from *cōma*.

26. A vowel before final *lo* or *lor* is long; as *cālo*, *cēlo*, *pīlo*, *sōlo*.

So *hālo*, *mālo*, *vēlo*, *sīlo*, *nōlo*, *pālor*, *sōlor*, *pecūlor*, and several others.

Excipit, ac fessos opibus *sōlatur* amicus. Virg.

1. Except ¹ālo, ²cālor, ³cōlor, ⁴dōlo (⁴noun or ⁵verb), ⁶dōlor, ⁷mōlo, ⁸ventīlo, ⁹vōlo, and ¹⁰cōlo-ēre, to cultivate, but ¹¹cōlo-āre, to filter, follows the general rule.

2. Also the penultimate of ¹²consūlo is short, from *consul-ūlis*; so ¹³gēlo from *gēlu*, and ¹⁴assimīlo from *simīlis*.

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3. Except

3. Except also ¹⁵ verbs in *ulo* or *ulor*, which are generally derived from diminutives in *ulus*; as *circulo*, *circulor*, from *circulus*.

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| 1. Tutius et geminos inxia mater alit. | Propert. |
| 2. Et color extremus primo cum frigore mixtus. | Lucret. |
| 3. Mille trahens varios adverso Sole colores. | Virg. |
| 4. Pila manu, seseque gerunt in bella dolones. | Virg. |
| 5. Materiemque dolare, levare ac radere tigna. | Lucret. |
| 6. Nulla fides damnis, veritque doloribus adlit. | Hor. |
| 7. Molendum usque in pultrino; vapulandum; habendus }
compedes. | Ter. |
| 8. Ventilet ætivum digitis sudantibus aurum. | Juven. |
| 9. Cæpere: alternos Musæ meminisse videbunt. | Virg. |
| 10. Igne Trojanum, et Vestam colit Alba minorem. | Juven. |
| 11. Et colare vagos inductis retibus amnes. | Manil. |
| 12. Utrique; id oro te, in commune ut consulas. | Ter. |
| 13. Nec Pallas spectare potest: vultusque gelaissent. | Lucan. |
| 14. Grandia si parvis assimilare licet. | Ovid. |
| 15. Licet superbus ambules pecunia. | Hor. |

Note.—Ainsworth has *bombilo*, which should be *bombito*. See *Facciolatus*.

27. A vowel before final ¹bes and ²ges is long; as *nûbes*, *ambâges*.

So *lâbes*, *tâbes*, *pûbes*, *compâges*, *impâges*, *ilrâges*, *frûges*, &c.

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| 1. Sub pedibus videt nûbes et sidera Daphnis. | Virg. |
| 2. Jam catervatim dat stragem atque aggerat ipsi. | Virg. |

Except ¹hêbes, ²indiges, ³lêbes, ⁴sêges, and ⁵têges.

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|--|--------|
| 1. Utque hêbeti pectus tantummodo contudit ictu. | Ovid. |
| 2. Dii patrii indigetes et Romule Vesique mater. | Virg. |
| 3. Tertia dona facit geminos ex are sêbetes. | Virg. |
| 4. Illa siges demum votis respondet avari. | Virg. |
| 5. Infitor hybernæ tîgetis, niveique caducei. | Juven. |

28. A vowel before final ¹des and ²pes is short; as *fîdes*, *tâpes*.

So *analectides*, *anterides*, *hyâdes*, *pleiâdes*, *sûdes*, and all masculine patronymics, according to the first rule; so also *âpes*, *dâpes*, *trâpes*, and the following compounds of *pes*, *bîpes*, *trîpes*, *quadrîpes*, *centîpes*, *antipôdes*, *celerîpes*, *gracilîpes*, *alîpes*, *levîpes*, *sonîpes*, *cornîpes*, *ignîpes*, *longîpes*, *lorîpes*, *palmîpes*, *solidîpes*, *caprîpes*, &c.

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|--|-------|
| 1. Mens bona, fama, fîdes, hæc clarè, et ut audiat hospes. | Perf. |
| 2. Infratos ostro atipedes pietique tîpetis. | Virg. |

1. Except ¹clâdes, ²sêdes, ³rûpes, ⁴sêpes, and ⁵stîpes.

2. And though we are without poetic authority for *carcinôdes*, *caulôdes*, *horminôdes*, yet their penultimate is evidently long from the Greek ω ; so *epôdes*; as $\kappa\alpha\rho\kappa\upsilon\omega\delta\epsilon\varsigma$, $\kappa\alpha\upsilon\lambda\omega\delta\epsilon\varsigma$, $\eta\rho\mu\iota\omega\delta\epsilon\varsigma$, $\epsilon\pi\omega\delta\epsilon\varsigma$.

- | | |
|---|--------|
| 1. Glâdibus irruimus nocituraque poscimus arma. | Lucan. |
| 2. Ducit ad infernas per multa silentia sêdes. | Ovid. |
| 3. Ille, velut pelagi rûpes immota resistit. | Virg. |
| 4. Texendæ sîpes etiam, et pecus omne tenendum est. | Virg. |
| 5. Stîpitibus duris agitur sūdibusque præsulis. | Virg. |

Note.—The classical existence of *trâdes* seems not to be satisfactorily proved: Ainsworth and Facciolatus cite only one authority, Tacit. Ann. 3. 46, where commentators propose *sûdes*, as a better reading.

29. A vowel before final ¹dex, ²dix, ³lex, ⁴mex, ⁵nix, or ⁶rex, is long; as *côdex*, *râdix*, *illex*, *cîmex*, *jûnix*, *cârex*.

So *jûdex*, *lôdex*, *spâdix*, *hâlex*, *pûlex*, *pûmex*, *râ-mex*, *tômex*, *rêmex*, *mûrex*, *sôrex*, &c.

- | | |
|---|--------|
| 1. Inde porrò ad puteum, atque ad robustum cōdicem. | Plaut. |
| 2. Pronus ab arborea cecidit rādice retentus. | Ovid. |
| 3. Procumbunt piecæ, sonat ista securibus illex. | Virg. |

- | | |
|---|--------|
| 4. Cui domus et uleses latebroso in puncto nidi. | Virg. |
| 5. Quàm mox horfum ad stabulum jūnix recipiat se r }
pabula. | Plaut. |
| 6. Et Calabrum coxit vitatio mūxier vellus. | Perf. |

Except ¹cûlex, ²sîlex, and ³rûnex.

- | | |
|--|--------|
| 1. Tota abit hora. Mali cûlices, ranæque palustres. | Hor. |
| 2. Spem gregis, ah! sîlice in nudâ connixa reliquit. | Virg. |
| 3. Apponunt rûmîcem, brassicam, betam, blitum. | Plaut. |

Note.—Alex, in the best authors and editions, is read *alec*, and is therefore no exception to this rule.

30. A vowel before final ¹per and ²ter is short; as *sûper*, *arbitr*.

So *âper*, *câper*, *îter*, *lâter*, *accipîter*, *diamêter*, *pâter*, *Jupîter*, *Discipîter*, and all adverbs in *ter*; as *alîter*, *amplîter*, *acriter*, *celeriter*, and many others.

- | | |
|--|-------|
| 1. Dum juga montis âper, fluvios dum pîseis, amabit. | Virg. |
| 2. Non locus effusi latè maris arbitr, autèr. | Hor. |

1. Except ¹nûper, ²âter, ³frâter, ⁴mâter, ⁵crâter, ⁶dêter, ⁷têter.

2. Uter-tra-trum follows the general rule; but ⁸ûter-tris, a bag, lengthens the penultimate.

3. Also ⁹sôter from $\sigma\omega\tau\eta\rho$, of which the poets give no example, except through its derivative *sôteria*.

- | | |
|---|--------|
| 1. Nunc huc remisit nûper ad me epistolam. | Plaut. |
| 2. Caledus immitte dimittitur ûter in urnam. | Ovid. |
| 3. Cui volet, importunus ebur; frâter, pater, adde. | Hor. |
| 4. Cui mâter mediâ sese tulit obvia sylvâ. | Virg. |
| 5. Tum pater Anchises magnum crâtera coronâ. | Virg. |
| 6. Nam dêterioris onânes cinnus licentiâ. | Ter. |
| 7. Têter ut immundæ carnis abiret odor. | Mart. |
| 8. Mollibus in pratis unctos saliere per ûtres. | Virg. |
| 9. Nam quoties furgis, sôteria pîseis amicos. | Mart. |

31. A vowel before final ¹ba, ²bo, ³pa, ⁴po, is short; as *fâba*, *lîbo*, *sâpa*, *nuncîpo*.

So *jûba*, *syllâba*, *cîbo*, *prôbo*, *glôbo*, *cûbo*, *ar-rhâbo*, *scâbo*, *nêpa*, *lûpa*, *pôpa*, *upûpa*, *alâpa*, *crîpa*, *legicrêpa*, *metôpa*, *crêpo*, *ilrêpo*, *câpo*, *occûpo*, *emancîpo*, *particîpo*, *anticîpo*, &c.

- | | |
|--|---------|
| 1. Densa jûba, et dextro jactata recumbit in armo. | Virg. |
| 2. Non auro, myrrhaque bibunt: sed gurgite puro. | Lucan. |
| 3. Et Laetanie nigra legena sîpe. | Mart. |
| 4. Adfidet, et totum prope faucibus obeûpat amnem. | Lucret. |

Except ¹glêba, ²scrîba, ³scrîbo, ⁴lîbo, ⁵nûbo, ⁶bûbo, ⁷cêpa, ⁸râpa, ⁹scôpa, ¹⁰clêpo, ¹¹stîpo.

- | | |
|---|--------|
| 1. Liquitur, et Zephyro patris se glêba resolvit. | Virg. |
| 2. Linqumus, infanti ridentes præmia scrîbæ. | Hor. |
| 3. Sumite materiam vestris, qui scrîbitis æquam. | Hor. |
| 4. Purpureosque metunt flores, et flumina libant. | Virg. |
| 5. Is nûbant, et illos ducere eadem hæc lex jubet. | Ter. |
| 6. Solaque culminibus ferali carmine bûbo. | Virg. |
| 7. Cadenda est hortis eruta cêpa meis. | Ovid. |
| 8. Hæc tibi brumali gaudentia frigore rôpa. | Mart. |
| 9. Vilibus in scôpis, in mappis, in scobe, quantus. | Hor. |
| 10. Qui hæc habent consilia; ubi data occasio est, rape, }
clipe, tene, harpaga. | Plaut. |
| 11. Stipant, et liquido distendunt nectare cellas. | Virg. |

Note.—Cûpa, sîupa, and pûpa, are sometimes more properly spelled *cuppa*, *stappa*, *puppa*; since this latter orthography designates their quantity, and is more consistent with their derivation from $\kappa\upsilon\pi\epsilon\alpha$, (French *coupee*), $\sigma\upsilon\tau\tau\eta$, &c. Côpa and cêpo seem corrupted readings for *caupo*, which the more accurate editions substitute.

32. A vowel before final *ga* is long; as *stôga*.

So *aurîga*, *bîga*, *quadrîga*, *collêga*, *sâga*, *pÿga*, *rûga*, *fanguisûga*, *folipûga*, &c.

At Novius *collêga* gradu post me sedet uno.

Hor.

Except ¹calîga, ²oslîfrâga, ³tôga, and the ⁴derivatives of *fûgo*, as *fûga*, *perfûga*, *lucifûga*, *lucrifûga*.

QUANTITY.

1. Caesar cognomen *caligæ* cui castra dederunt.
2. Adcipites, atque *offisræga*, meretricæ, marinus.
3. Lās numquam, *toga* rara, mens *quieta*.
4. Quā ventī incubuere, *fūgam* dant nubila cælo.

Auson.
Lucret.
Mart.
Virg.

33. A vowel before final *go* is long; as imāgo, orīgo, inlīgo.

So ærūgo, rūgo, aurīgo, sulīgo, compāgo, cartilāgo, consilīgo, calīgo, frīgo, mīgo, helperūgo, sūgo, fustlāgo, &c.

Adjūrate meis, primāque ab *origīne* mundi.

Ovid.

1. Except ¹ēgo, ²fūgo, ³harpāgo, līgo (⁴noun or ⁵verb), ⁶rēgo, ⁷rīgo, ⁸rōgo, ⁹strīgo, ¹⁰tēgo.
2. Also ¹¹congrēgo is short, from grex-grēgis; and ¹²jūgo, from jūgum.

3. ¹³Lēgo-ere of the third conjugation shortens the penultimate; but ¹⁴lēgo-are, of the first, lengthens it.

4. Except also ¹⁵āgo, and its ¹⁶compounds; as nēgo, navīgo, litīgo, mitīgo, &c. It is to be observed, however, that when the ¹⁷compound has been formed by syncope or erasis, the penultimate, according to the rule for contracted syllables, becomes long; as fatīgo, from fatum or affatim and ago; indāgo, from inde and ago; farrāgo, from furre and ago; vertīgo, from vertendo and ago; castīgo, from castum and ago; dēgo, from de and ago, &c.

1. & 12. Quas *ēgo* non gentes, quas non face corda *jūgari*. Stat.
2. Trans pontum *fūzat*, et terris immitit apricis. Virg.
3. Confutit blandiloquentulus, *harpāgo*, mendax, euppēs, } Plaut.
avarus.
4. Longis purgare *līgonibus* arva. Ovid.
5. Dissociata locis concordī pace *ligarūt*. Ovid.
6. Pacatumque *rēget* patriis virtutibus orbem. Virg.
7. Prata *rīget* fons interdum, campiūque redundet. Lucret.
8. Sacerdos, id faciam; atque aquam hinc de proximo } Plaut.
rīgabo.
9. Namque ubi *strīgandum* est, et ubi currendum, scio. Phædr.
10. Superba jactas, *tēgere* quod debet pudor. Phædr.
11. Inde ea comprehendit inter se, conque *grīgantur*. Lucret.
12. Qui *lēgitis* flores, et humi nascentia fraga. Virg.
13. Quin potius, quod *līgatum* est tibi negotium. Plaut.
14. Et potum, pallas *āgo*, Tityre, et inter *āgendum*. Virg.
15. Hoc etiam fœvas paulatim *mīlgat* iras. Ovid.
16. Confutit animum *fatīgus*? Hor.

34. A vowel before final ¹gus, ²gum, or ³gium, is short; as pelāgus, jūgum, navīgum.

So asparāgus, catalōgus, confrāgus, naufrāgus, of-
fistrāgus, dialōgus, epilōgus, etholōgus, elēgus, luci-
fūgus, indīgus, noctivāgus, māgus, rōgus, the noun
sāgus or sāgum; conjūgium, elōgium, fortīlēgium,
naufrāgium, prodīgium, diffūgium, perfūgium, horo-
lōgium, remīgium, sacrilēgium, aquilēgium, confū-
gium, &c.

1. Materie tanto in *pelāgo*, turbāque alienā? Lucret.
2. Robustus quoque jam tauris *jūga* solvet arator. Virg.
3. Excipe *naufrēgium* non duro litore nostrum. Ovid.

1. Except fāgus, ²frāgum, ³frīgus, ⁴pāgus, and the adjective ⁵sāgus.

2. Also ⁶contāgium, ⁷fastīgium, ⁸fustrāgium, ⁹ves-
tīgium.

3. And ¹⁰chorāgus, ¹¹chorāgium from χορήγοι, χορη-
γων; and ¹²pædagogus from αγω.

1. Tityre, tu patula recubans sub tegmine *fūgi*. Virg.
2. Arbuteos fatus, montanaque *frāga* legebant. Ovid.
3. Ante focum, si *frīgus* erit, si mellis in umbrā. Virg.
4. Quām si me toto laudet vicinia *pāgo*. Juven.
5. Ipse nihil certum *sāgis* clangoribus æther. Stat.
6. Nec mala vitæ pecoris *contāgia* latent. Virg.
7. Ambages; sed summa sequar *fustigia* rerum. Virg.
8. Libera si dentur populo *sustrāgia*, quis tam, &c. Juven.
9. Pauca tamen suberunt *pricæ vestigia* fraudis. Virg.

10. Ipse ornamenta a *Chorāgo* hæc sumpsit suo periculo. Plaut.
11. Nam hoc pane iniquum est Comico *chōragio*. Plaut.
12. Mihi *pædagogus* fuerat, quasi uti mihi foret. Plaut.

35. A vowel before final ¹va, ²ve, ³ves, ⁴vis, ⁵vo, ⁶vus, is long; as clāva, proclīve, dīves, cīvis, pāvo, rīvus.

So cēva, convīva, diva, gingīva, pāva, prærogatīva, ūva, æstīva, olīva, conclāve, nēve, clāvis, fuāvis, nāvis, rāvis, acclīvis, declīvis, proclīvis, vīvo, prāvo, rīvo, nāvo, prīvo, æstīvo, flāvus, ignāvus, æstīvus, dīvus, ōvum, prāvus, and all adjectives ending in *ivus*, which are numerous.

1. Ducerit apricis in collibus *ūva* colorem. Virg.
2. Currere per totum pavidi *conclāve* magisque. Hor.
3. *Dives* agris, *dīves* positus in fanere nummis. Hor.
4. Nec prohibent *clāves*, et canis ipse tacet. Tib.
5. Uleris os; alitur vitum, *vīvūque* tegendo. Virg.
6. Tam ficti *prāvique* tenax, quām nuncia verū. Virg.

1. Except ¹āvis, ²brēvis, ³grāvis, ⁴lēvis, ⁵ōvis.

2. Also ⁶cāvo, ⁷grāvo, ⁸jūvo, ⁹lāvo, ¹⁰lēvo, ¹¹nōvo, ¹²ōvo.

3. And ¹āvus, ²cāvus, ³fāvus, ⁴nōvus.

1. Fiet aper, modō *āvis*, modō saxum, et, cum volet, arbor. Hor.
2. Vitæ summa *brēvis* ipem nos vetat inchoare longam. Hor.
3. Reddit, ubi *Æoliden* fixum *grāve* Sisyphon urget. Ovid.
4. Ante *lēves* ergo pascuntur in æthere cervi. Virg.
5. Insistit, Pan curat *dīves*, *ivūque* magistros. Virg.
6. Dura tamen molli taxa *cūvantur* aquā. Ovid.
7. Unde *grāvet* pennas; si celsior ignis adurat. Ovid.
8. Temperie cæli, corporūque, animūque *jūvantur*. Ovid.
9. Prandeo, poto, cano, ludo, *lūvo*, cano, quiesco. Mart.
10. Cantantes ut eamus, ego hoc te fasce *lēvabo*. Virg.
11. Nec remorantur ibei: sic rerum summa *nōvantur*. Lucret.
12. Quo nunc *Turnus* *ovat*, spolio gaudentque potitus. Virg.
13. Stat fortuna domus et *ivū*, numerantur *ivorū*. Virg.
14. Sed tūm fortē *cūm* dum personat æquora conchā. Virg.
15. Mella *fāvīs*, illi tiliaz atque uberrima *pīnus*. Virg.
16. Pura *nōvum* vati laurea mollit iter. Propert.

36. A vowel before final *ca* is long; as spīca, formīca, festūca.

So antīca, apīca, cloīca, carrūca, eurtūca, erīca, mīca, myrīca, lactūca, lectīca, noctilūca, rīca, ru-
brīca, lorīca, pīca, pastināca, phōca, sambūca, sīca, urtīca, vestīca, &c.; and several ending in *theca*, from *thēka*, as apothēca, bibliothēca, oporothēca, &c.

Parvula nam exemplo est, magni *formica* laboris. Hor.

Except ¹alīca, ²brafsīca, ³fulīca, ⁴mantīca, ⁵per-
tīca, ⁶tunīca, ⁷falarīca or phalarīca, ⁸dīca.

1. Nos *alīcam*, nullum poterit tibi mittere dives. Mart.
2. Me notat, et junco *brafsīca* vincita levi. Propert.
3. In sicco ludunt *fulicæ*, notatque paludes. Virg.
4. *Mantīca* cui lumbos onere ulceret, atque eques armos. Hor.
5. *Pertīca* dat plenis immitia vulnere ramis. Ovid.
6. Sufficiant *tunicæ* fummis *Ædilibus* albæ. Juven.
7. Sed magnum stridens contorta *falarīca* venit. Virg.
8. Ceddē dum, en unquam injuriarum audisti mī scriptam } Ter.
dīcam.

Note.—1. Aphāca is rather aphāce-es from ἀφᾶκη, and therefore does not relate to this rule.

2. And since adjectives in *ivus* shorten the penultimate; wherever the termination *ica* is derivable from an adjective in *ivus*, though the adjective itself be not in use, the penultimate is short by derivation; as,

Piratica from piraticus; *i. e.* ars piratæ piratica.
Fabrica from fabricus; *i. e.* officina fabri fabrica.
Flaminica from flaminicus; *i. e.* femina flaminis flaminica.
Manica from manus; *i. e.* vestis magūs manica.
Pedicæ from pedicus; *i. e.* catena pedis pedica.
Lucanica from Lucanius; *i. e.* esca Lucanorum lucanica.
Bucolica from bucolicus; *i. e.* carmina *βουκολιαστῶ* bucolica.
Basilica from basilicus; *i. e.* aula *βασιλικῶς βασιλική* vel basilica.
Arithmetica from arithmeticus; *i. e.* *σέχνη ἀριθμῶν* arithmetica.
Mnemonica from *μνημονικός*; *i. e.* *σέχνη μνήμης* mnemonica.

QUANTITY.

37. Words ending in *'aris* or *'are* lengthen the penultimate; as *alāris*, *altāre*.

So *agricolāris*, *peculiāris*, *nāris*, *alveāre*, *capillāre*, *plantāre*, *quāre*, and many others.

1. *Suspiciens*, *patulis* captavit *nāribus* auras. Virg.
2. *Suspicit* exigui *latum plantāribus* horti. Juv.

Except *'hilāris*, *'bimāris*, *'canthāris*, *'cappāris*, *'māre*, and *'dāre*.

1. *Oderunt hilārem* tristes, *tristemque* iocosi. Hor.
2. *Aut Ephefū bimārisque* Corinthi. Hor.
3. *Cantharidum* succos, *dante* parente, *bibas*. Ovid.
4. *Cappārin*, et *putricepas* alere *natantes*. Mart.
5. *Ante māre* et *tellus*, et *quod tegit* omnia *cælum*. Ovid.
6. See, for *dūre*, the verbal increment in *a*.

38. Words ending in *'elis*, *'elus*, *'ela*, *'elum*, *'ofus*, *'udus*, *'ator*, *utor*, lengthen the penultimate; as *fidēlis*, *phasēlus*, *suadēla*, *prēlum*, *fumōfus*, *sūdus*, *orātor*, *ūtōr*.

So *crudēlis*, *carduēlis*, *patruēlis*, *candēla*, *loquēla*, *querēla*, *corruptēla*, *cicindēla*, *clientēla*, *mustēla*, *nitēla*, *Philomēla*, *parallēlus*, *polymēlus*, *arenōfus*, *formōfus*, *luctuōfus*, *perniciōfus*, *nūdus*, *crūdus*, *lūdus*, *ūdus*, and many others.

1. *Nunquam est fidēlis* cum *potente* societas. Phædr.
2. *Et circum piētis* vehitur *sua rura phasēlis*. Virg.
3. *Qualis populeā mærens Philomēla* sub *umbrā*. Virg.
4. & 5. *Coloque prēlorum fiamōfis* deripe *tectis*. Virg.
6. *Quid Nero tam sævā, crudēlique* tyrannide *fecit*? Juv.
7. *Hinc altā* sub *rupe* canet *frondātor* ad *auras*. Virg.
8. *Nec soleas* fecit; *sūtor* tamen *est sapiens*. Qui?— Hor.

39. Words ending in *'ober*, *'uber*, or *'aver*, lengthen the penultimate; as *Octōber*, *salūber*, *papāver*.

So *sūber*, *tūber*, *ūber*, *hūber*, *pūber*, *cadāver*, &c.

1. *Te taceo, Octōber* fœnere *dirat* agros. Aufon.
2. *Quique frequens* herbis et *fertilis ūbere* campus. Virg.
3. *Lillia purpureis* mista *papāveribus*. Prop.

Except *'colūber* and *'rūber*.

1. *Inque pruinoso colūber* distendit *arvo*. Lucan.
2. *Crine rūber*, *uiger ore*, *brevi pede*, *lumine læsus*. Mart.

40. Adverbs in *'tim* lengthen the penultimate; as *oppiātīm*, *virītīm*, *tribūtīm*: except *'stātīm*.

1. *Et velut absentem certāīm* *Acēlæona* clamant. Ovid.
2. *Nec spernat* auris, *nec tamen* credat *stātīm*. Phædr.

Note.—“*Nostri Lexica*, *Grælusque* ad *Parnas*. Penultimam adverbii, *affatīm*, *longā* apice *signant*. Nec eo *infeias*, quin *poetæ* *degeneris Latinitatis* *eam* *produxerint*.” Vide tamen *Lexicon Faccioliati*, ubi hanc *observationem* *invenies*, “*Annianus poeta*, *apud Gell.* *l. 7. c. 7.* *ita disputat* de *quantitate penultimæ*, *ut statuatur* *eam esse corripendam*: *innuat*, *autem*, *olim etiam productam fuisse*: *quod et ab Aratore factum est. l. 2. in Ac. Apostol. v. 326.* *Verūm non est hoc satis*, *ut contra communem usum produci possit.*”

41. Words ending in final *quus* are compounded with *æquus*, and therefore lengthen the penultimate; as *antiquus*, *iniquus*, *obliquus*.

Terra *antiqua*, *potens armis* atque *ubere glebæ*. Virg.

Except *relīquus*, which is not derived from *æquus*, and is therefore excepted.

Texantur reliqua *tecta palude* *tibi*. Mart.

Note.—Though the real cause of the penultimate of *inīquus*, *antīquus*, &c. being long, is the contraction of the *æ*, of *æquus*, from which they are derived, *into ī*, which is therefore long, according to the rule we have given for contraction: yet since the above may be a more obvious distinction than a latent cause, we have not thought it improper to add it. And since this remark is applicable to some other terminations and examples, noticed in this analysis, it is sufficient here, once for all, to give this general answer.

42. Words ending in *pōla*, or *pōlium*, being derived

from *πώλειν*, lengthen the vowel before *l*; as *bibliopōla*, *œnopōlium*.

So *myropōla*, *myropōlium*, *propōla*, *pharmacopōla*, &c.

1. *Sed qui me* *vendit Bibliopōla* *putat*. Plaut.
2. *Nam omneis plateas* *perreptavi*, *gymnasia* et *myropōlia*. Plaut.

43. Words ending in *'areo*, *'arius*, *'erium*, *'orius*, lengthen the antepenultimate; as *pāreo*, *cibārius*, *acrotērium*, *meisōrius*.

So *āreo*, *clāreo*, *hordeārius*, *sextārius*, *librārius*, *mercenārius*, *herbārius*, *capistērium*, *dictōrium*, *ecclesiastērium*, *nicetērium*, *sphæristērium*, *adulatōrius*, *centōrius*, and many others.

1. *Vim geminam* *sentit*, *pāretque* *incerta duobus*. Ovid.
2. *In hunc diem* *jā tuus sum mercenārius*. Plaut.
3. *Omnibus arides*, *dictōria* *ilicis* *in omnes*. Mart.
4. *Quem censōria* *cum meo* *severo*. Mart.

1. Except *'cāreo*, *'vārius*, and *'nectāreus*, from *nectār-is*.

2. Also *'desidērium*, from *desidēro*; *'magistērium*, from *magistēr*; and *'ministērium*, from *ministēr*.

3. And the *derivatives* of *genitives* increasing in short *ōris*; as *æquōreus*, *arbōreus*, *castōreus*, *corpōreus*, *ebōreus*, *marmōreus*, *stercōreus*, *robōreus*, from *æquor-ōris*, *arbor-ōris*, *castor-ōris*, *corpus-ōris*, *ebur-ōris*, *marmor-ōris*, *stercus-ōris*, *robur-ōris*.

4. Except also some *derivatives* from *o* (omicron), as *bōreus*, *antibōreus*, *hyperbōreus*, from *βορέας*.

1. *Scilicet* et *morbis* et *debilitate cūrebis*. Juv.
2. *Et vīrias* *usus* *meditando* *extunderat artes*. Virg.
3. *Attica nectāreum* *turbatis* *mella* *salernum*— Mart.
4. *Roma*, *domusque* *subit*, *desidēriumque* *locorum*. Ovid.
5. *Virtute*, *id factum*, *tuā*, et *magistērio* *tuo*. Plaut.
6. *Festa ministēriis* *mulces*, *reparatque* *labori*. Ovid.
7. *Arborea* *frondes* *auro* *radiante* *nitentes*. Ovid.
8. *Vita* *procul patria* *peragenda* *sub axe* *Borea*. Ovid.

44. Words ending in *'aceus*, *'afeus*, *'aneus*, *'eneus*, *'oneus*, lengthen the antepenultimate; as *testāceus*, *cāceus*, *fubitāneus*, *ahēneus*, *idōneus*.

So *arenāceus*, *hederāceus*, *hordeāceus*, *refināceus*, *cretāceus*, *arāneus*, *conditāneus*, *rejeclāneus*, *collectāneus*, *bipedāneus*, and many others.

1. *Herbas utiliores argillācea* *terra*. Var.
2. *Pinguis* et *ingratæ* *premeretur cāceus* *urbi*. Virg.
3. *Nec nebula noctū*, *neque arānei* *tenuia* *fila*— Lucr.
4. *Si rectē* *facies*: *hic murus ahēneus* *est*. Hor.
5. *Opportunus* *ita est* *si forte* et *idōneus* *aër*— Lucr.

1. Except *castāneus*, from *castānea*.

Castāneæque *nuces*, *mea* *quas* *Amaryllis* *amabat*. Virg.

45. Words ending in *'icius*, *'icium*, or *'itius*, shorten the antepenultimate; as *patrīcius*, *ædificīum*, *ædilitius*.

Patrīcius *omnes* *opibus* *cūm* *provocet* *unus*. Juv.

So *gentilīcius*, *tribunīcius*, *adventīcius*, *factīcius*, *auspīcius*, *judīcius*, *artificīum*, *aruspīcius*, *malefīcium*, *benefīcium*, *opificīum*, *extispīcius*, *harruspīcius*, *sacrificīum*, *indīcium*, *offīcium*, *panefīcium*, and many others.

1. Except *'novīcius*, or *novitius*; and those which come from long *supines*; as *effutitius*, from *effutio*, *ire*, *ivi*, *itum*.

2. Also *'convīcius*, *'licium*, and *'nutrīcium*, from *nutrix-icis*.

1. *Jam* *fedet* *in ripa* *tetrūmque* *novīcius* *horret*. Juv.
2. *Neve* *in me* *stolidæ convicia* *funere* *linguæ*. Ovid.
3. *Et pressos* *domitare* *boves*, et *licia* *telæ*. Virg.
4. *Omniaque* *infantum* *mixta nutrītia* *turba*— Manil.

46. Words

QUANTITY.

46. Words ending in ¹ *aticus*, ² *atilis*, ³ *etudo*, ⁴ *atio*, ⁵ *utio*, lengthen the antepenultimate; as *aquaticus*, *aquatilis*, *valétudo*, *festinatio*, *locutio*.

So *pluviatilis*, *placitilis*, *defectudo*, *crematio*, *balbutio*, and many others.

- | | |
|--|--------|
| 1. Calcavere pedis, nec solvit <i>aquaticus</i> Ausler. | Ovid. |
| 2. Labitur occultè, fallitque <i>volatilis</i> aëras. | Ovid. |
| 3. Gratia, fama, <i>valétudo</i> contingat abunde. | Hor. |
| 4. Seclèstæ hæc sunt aëdes, impia est <i>habutatio</i> . | Plaut. |
| 5. <i>Bolbutit</i> scaurum, pravis sultum malè talis. | Hor. |

Except some ending in *māticus*, from neuters in *ma-ātis*; as *aromaticus*, from *aroma-ātis*; *rheumaticus*, from *ῥέυμα-ατος*; *grammaticus*, from *γράμμα-ατος*; and *hepaticus*, from *hepar-ātis*.

Grammaticas ambire tribus, et pulchra dignor. Hor.

47. *Abilis* lengthens the antepenultimate; so does *ibilis*, when from long preterites in *ivi*; otherwise it shortens it, as *amābilis*; *expetibilis*, from *expeto*, *ivi*, *itum*; *terribilis*, from *terreo*, *ūi*, *itum*.

- | | |
|---|-------|
| Accipiam, cunctisque meum <i>lætabile</i> factum. | Ovid. |
| <i>Terribilis</i> squalore Charon; cui plurima mento— | Virg. |

48. ¹ *Abulum*, ² *aculum*, ³ *ecula*, lengthen the antepenultimate; ⁴ *iculum*, ⁵ *icula*, shorten it; as *pābulum*, *gubernāculum*, *apēcula*, *ridiculus*, *auricula*.

- | | |
|---|---------|
| 1. <i>Pābula</i> parva legens, nidisque loquacibus escas. | Virg. |
| 2. Omnia transformat sese in <i>mirācula</i> rerum. | Virg. |
| 3. Aut ursum, aut pugiles; his nam <i>plēcūla</i> gaudet. | Hor. |
| 4. Quam ex hoc fonticulo tantundem fumere. Eò fit. | Hor. |
| 5. Humanum genus est avidum nimis <i>auricularum</i> . | Lucret. |

Except ¹ *periculum*, and ² some long by derivation; as *hædiculus*, from *hædile*; *redimiculus*, from *redimio*, *ivi*, &c.; *loricula*, from *lorica*; *posticulus*, from *posticus*; *nutricula*, from *nutrix-icis*.

- | | |
|---|-------|
| 1. Sed tibi vexatæ per multa <i>pericula</i> vitæ. | Prop. |
| 6. Et tunice manicas et habent <i>redimicula</i> mitræ. | Virg. |

49. Words ending in ¹ *ācium*, ² *ēlia*, ³ *fāriam*, lengthen the antepenultimate; as *mendācium*, *pittācium*, *contumēlia*, *multifāriam*.

- | | |
|--|--------|
| 1. Impercepta pia <i>mendācia</i> fraude latebant. | Ovid. |
| 2. Quod quum inquināssent omni <i>contumēlia</i> . | Phædr. |
| 3. Ut dispartirem obsonium hic <i>bisfāriam</i> . | Plaut. |

50. Numerals ending in ¹ *ni*, lengthen the penultimate; in ² *ginti*, ³ *ginta*, ⁴ *gies*, and ⁵ *ēsimus*, the antepenultimate; as *bini*, *sēni*, *vicēni*, *ducēni*, *viginti*, *octōginta*, *nonāgies*, *octōgies*, *vigēsimus*, *multēsimus*.

So *quīni*, *septēni*, *octōni*, *novēni*, *undēni*, *duodēni*, *tredēni*, &c.; *quadrāginta*, *quingūginta*, &c.; *quadrāgies*, *quingūgies*, &c.; *trigēsimus*, *quadragēsimus*, &c.

- | | |
|---|----------|
| 1. Bis <i>dēnas</i> Italo texamus robore naves. | Virg. |
| 2. <i>Viginti</i> tauros magnorum horrentia centum. | Virg. |
| 3. <i>Triginta</i> magnos volvendis mēsis orbis. | Virg. |
| 4. Phæbus <i>nonāgies</i> illucescit polum urumque. | Hippocr. |
| 5. Bis jam pene tibi consul <i>trigēsimus</i> instat. | Mart. |

51. Words ending in ¹ *ates*, ² *itis*, ³ *otis*, ⁴ *ota*, and ⁵ *eta*, lengthen the penultimate; as *vātes*, *vītes*, *caryōtis*, *diōta*, *mēta*.

So *crātes*, *penātes*, *mītes*, *chalcītis*, *pleurītis*, *ampelītis*, *arthrītis*, *caprītis*, *mephītis*, *caryōta*, *cestrōta*, *bēta*, *crēta*, *cofmēta*, *comēta*, *poēta*, *sēta*, &c.

- | | |
|--|-------|
| 1. Cælicolæ, clarique suos posuere <i>penātes</i> . | Ovid. |
| 2. Contuderit <i>vites</i> , cleamve momorderit æstas. | Hor. |
| 3. Et notas <i>caryōtides</i> theatris— | Mart. |
| 4. O Thaliarche merum <i>diōtæ</i> — | Hor. |
| 5. Quorum abeant sani? <i>crētæ</i> an carbone notandi?— | Hor. |

Except ¹ *pōtis*, ² *sītis*, ³ *nōta*, ⁴ *rōta*, ⁵ *drapēta*.

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|--|---------|
| 1. Quis <i>pōtis</i> est, nisi vis animæ, quæ membra gubernat. | Lucret. |
| 2. Depositura <i>sītis</i> vicini fontis in undâ. | Ovid. |
| 3. A quo repulsi tristem sustinuit <i>nōtam</i> . | Phædr. |
| 4. Hic neque tum solis <i>rōta</i> cerni, lumine largo. | Lucret. |
| 5. Constant, conferunt sermones inter sese <i>drapēta</i> . | Plaut. |

52. Lastly; the following final syllables lengthen the preceding vowel, ¹ *nar*, ² *cal*, ³ *gal*, ⁴ *nal*, and ⁵ *tal*; as *lacūnar*, *pulvīnar*, *cervicā*, *vestīgā*, *Bacchānal*, *minūtal*, and some others.

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|---|--------|
| 1. Mēa renidet in domo <i>lacūnar</i> . | Hor. |
| 2. Tinge caput nardi folio, <i>cervicā</i> olebit. | Mart. |
| 3. Jurgatur verbis: ego <i>vestīgālia</i> magna. | Hor. |
| 4. <i>Bacchānal</i> te exercuisse, quom qui sis, alium roges? | Plaut. |
| 5. Hesternum solitus medio fervere <i>minūtal</i> . | Juven. |

53. Also, whatever terminations are naturally derivable from any of the preceding final syllables, lengthen or shorten, according to their primitive termination, their penultimate, or antepenultimate syllable; as masculines ending in *ārius*, may form feminines in *āria*, and neuters in *ārium*; so *ōrius*, *ōria*, *ōrium*; *ētus*, *ēta*, *etum*, &c. as *arārius*, belonging to copper or brass; *arāria*, a copper mine; *arārium*, a treasury; hence *rosārium*, *pomārium*, *muscārium*, *meritōrium*, *quercētum*, *rosētum*, *palmētum*, &c.

Note.—1. And it should be recollected, that since compounds and derivatives follow the quantity of their primitives, the compounds and derivatives of such words as form exceptions to any of these rules, will follow the general rule for the quantity of derivative words.

2. And it may be here necessary, finally, to remind the young profudiah of the same rule, since the quantity of many vowels is explicable solely by this law, and requires no other direction; as *ædilitius* from *ædilis*; *aliēnigena* from *aliēnus*; *contrādictio* from *contrā*; *aliquātenus* from *aliquā*, &c. Hence adjectives ending in *ax-ācis* form derivatives in *ācia*, *ācias*; as *capax-ācis*, *capacitas*, *audax-ācis*, *audācia*: in the same manner genitives increasing short, shorten the corresponding vowel of the derivative; as *cartilago-ginis*, *cartilagineus*, *cartilaginofus*. Thus preterites and supines having their penultimate long, lengthen accordingly the derivative vowel; as *dormito* from *dormio-ivi-itum*; *conditio*, *condititius* from *condio-ivi-itum*; *so conditio*, *conditus*, *conditor* from *condo-didi-ditum*: hence *arriso*, *arrisor*, *audicio*, *definitio*, are from *arrideo-risi-risum*, &c. Thus words ending in *ālis* may form derivatives in *ālia*, *ālitus*, *ālter*, *ālterus*, *ālcutus*; hence *cereālia*, *æquālitus*, *artificialiter*, *causalitius*, *canaliculus*, arise from the primitive termination *ālis*: and thus nouns in *ātio* have their derivatives in *ātiuncula*; as *ædificatio*, *ædificātiuncula*, &c.

54. I ¹ before or ² after *r*, is long; as *īra*, *scrīnium*.

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|--|-------|
| 1. <i>Īra</i> furos brevis est. Animum rege, qui nisi paret— | Hor. |
| 2. Mixtaque <i>ridenti</i> colocasia fundet acantho. | Virg. |

1. Except ¹ *hīrudo*, ² *hīrundo*, ³ *rīgo*, ⁴ *rīgeo*, ⁵ *trībus*, ⁶ *vīreo*.

2. Also, *ri* followed by ⁷ *c* is short; as *frīco*, *Afrīcus*, *fabrīco*, *lubrīco*, *currīculum*; yet ⁸ *lumbīcus*, ⁹ *rubrica*, ¹⁰ *trīcæ*, and its derivative ¹¹ *extrīco*, and ¹² *rīca*, follow the general rule.

3. And *ri* followed by a vowel, is short by the rule "a vowel before another," &c. as *penurīa*.

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|--|---------|
| 1. Qualis volo, vetulos duo; jam ego me convortam in <i>hīrudinem</i> — | Plaut. |
| 2. Pervolat, et pennis altaatria lustrat <i>hīrundo</i> . | Virg. |
| 3. Omnia quæ maria, ac terras, sparguntque, <i>rigantque</i> . | Lucret. |
| 4. Sanguine et igne micant oculi, <i>riget</i> horrida cervix. | Ovid. |
| 5. Et ditant Latias tertia dona <i>tritibus</i> . | Mart. |
| 6. Quo seges in campo, quo <i>viret</i> uva jugo. | Prop. |
| 7. <i>Africus</i> in glaciem frigore nescit aquas. | Prop. |
| 8. Foras, foras, <i>lumbīce</i> , qui sub terrâ erepsisti modò. | Plaut. |
| 9. Non fecds ac si oculo <i>rudricam</i> dirigat uno. | Perf. |
| 10. Litibus, neque <i>trīcis</i> : quam ob rem ego argentum numerem foras? | Plaut. |
| 11. Mercedem aut nummos unde unde <i>extrīcat</i> , amaras— | Hor. |
| 12. Supparum, aut subminiam, <i>ricam</i> , basilicum, aut exiticum. | Plaut. |

QUANTITY.

55. Y before or after R, is long; as Butyrum, collirium, papyrus.

1. Colliræ facite ut madeant et colliphia. Plant.
2. Succinctus patriâ quondam Cripine papyro. Juven.

1. Except ¹lachryma, ²lyra, ³corlylus, ⁴philyra, ⁵pyrus, ⁶fatyra, ⁷zephyrus.

2. And the derivatives of *ἔσφυρος*; as hydrargyros, lithargyros.

3. See the 3d exception to the last rule.

1. Et lacrymis spargunt rorantibus ora genasque. Lucret.
2. Sit tibi Musa lyra solers, et cantor Apollo. Hor.
3. Neve inter vites corlylum fere; neve flagella. Virg.
4. Ebrui incinctis philyrâ convivia capillis. Ovid.
5. Inferre nunc, Melibœe, pyros, pone ordine vites. Virg.
6. Sunt quibus in Satyrâ videar nimis acer, et ultra. Hor.
7. At verò Zephyris cum læta vocantibus æstas— Virg.

56. U ¹before or ²after R, is long; as lûridus, ūro, rûmor.

1. Neglectis ūrenda silix innascitur agris. Hor.
2. Quæ vos ad cælum effertis rûmori secundo. Hor.

1. Except ¹cûrulis, ²cærulus, ³fûro and fûror, ⁴frûtex, ⁵lemûres, ⁶nûrus, ⁷querûlus, ⁸rûdis, ⁹rûdens, ¹⁰rûbeo, ¹¹rûtilus, ¹²rûmex, ¹³tugûrium, ¹⁴fatûr-ûra-ûrum.

2. Except also *ri* in ¹⁵genitives, increasing short in *ûcis* or *ûris*, and their derivatives; as crux-crûcis, trux-trûcis, augur-ûris, murmur-ûris, sulphur-ûris, which give crûcio, trûcido, murmûro, augûrium, sulphûreus, and the like.

3. Also, ¹⁶meditatives in *ûrio* and *luxûrio*; as esûrio; ¹⁷other verbs in *urio* follow the general rule; as ligûrio, scatûrio.

4. U before final *r*, and *ru* followed by a vowel, are regulated by the rules for those circumstances; as augûr, fatûr, rûno.

1. Prætor adest vacuæque loco cessere cûrules. Lucan.
2. Adnixi torquent spumas, et cavilla verunt. Virg.
3. Quid fûris? Aut quonam nostri tibi cura recessit? Phædr.
4. Contextit illum frûctus, et admonuit simul. Phædr.
5. Nocturnus lenûres portentaque Thesala rides? Hor.
6. Cinctaque adest virgo matrum nûruumque catervâ. Ovid.
7. Et nunquam querûli causâ doloris adest. Ovid.
8. Quem dixere Chaos; rûdis indigestaque moles. Ovid.
9. Insequitur clauorque virum, fridorque rûdentum. Virg.
10. Purriceis inuicta rotis Aurora rûbrabat. Virg.
11. Robora complexus rûtilo curvata metallo. Lucan.
12. Apponunt rûmiceu, brassicani, betani, blitum. Plant.
13. Pauperis et tugûri congestum cespitem colmen. Virg.
14. Aut intus clausos fatûra ad præsepia fervant. Virg.
15. Vultus in unum me trices. Hor.
16. Græculus esûriens, in cælum iusseris, ibit. Juven.
17. Tractavit calicem manibus, dum furta ligûrit. Hor.

57. ¹O and ²U, before *m* are long; as vûmer, bû-mastus.

1. Ingemere, et sulco attritus splendescere vûmer. Virg.
2. Quale solet sylvis brûmali frigore viscum. Virg.

1. Except, to *o* before *m*, ¹cûmeta, ²cûmedo, ³ûmitto, ⁴tûmaclum.

2. Also atûmus, dûmus, glûmus, tûmus (for which see sect. 2, rule 5); cûma, cûmes (for which see sect. 2, rule 23); dûmo, hûmo, and vûmo; (for which see sect. 2, rule 25.)

1. Non secus ac liquida si quando nocte cûmeta. Virg.
2. Ut libet: hæc porcis hodie cûmedenda relinques. Hor.
3. Pleraque differat, et præfens in tempus ûmittat. Hor.
4. Quod fumantia qui tûmacla raucus. Mart.

3. Except, to *u* before *m*, ¹crûmena, ²cûmulus, ³hûmerus, ⁴nûmella, ⁵nûmerus, ⁶sûmus, ²tûmeo.

4. Also, colûnen, docûmentum, emolûmentum, te-

gûmen (for which see sect. 2, rule 22); humus, poitûmu- (for which see sect. 2, rule 5); cucûmis (for which see sect. 2, rule 23); and autûmo; (for which see sect. 2, rule 25.)

5. For circûmeo and circûmago, see the rule for *m* final.

1. Quid eum velit, homo, crûmenam sibi de collo detrâhit. Plant.
2. Exhaustum in cûmulos ûmûlq; in fluctibus unda est. Lucan.
3. Ipse solibo hûmeris: nec me labor iste gravabit. Virg.
4. Nervos, catenas, carcere, nûmellas, pedicas boias. Plant.
5. Rari quippe boni, nûmero vix sunt totidem, quot— Juv.
6. Alii simul delinquant, censores sûmus. Phædr.
7. Igne miant oculi, corpus tûmet omne veneno. Ovid.

58. U before *c* is long; as bûcula, dûco, cadûcus.

Vidi ego labentes acies, et tela caulica. Prop.

1. Except ¹lûcellum, ²lûcerna, ³nûcleus, ⁴volûcer.

2. And in ⁵genitives increasing short in *ûcis*, and their derivatives; as dux-ûcis, crux-ûcis, trux-ûcis; hence crûcio, trûcido, &c.

1. Quid puri tranquillet; honos, an dulce lûcellum— Hor.
2. Hæc ego non credam Venûfina digna lûcernâ. Juv.
3. Mella dari, nûcleosque jubet, dulcesque placentas. Mart.
4. Interea volûcer motis conterita pennis. Petron.
5. Abstraxitque hominem in maximam malam crûcem. Plant.

59. Syllables indifferently spelled with one or two consonants are long; as literæ or litteræ, litus or littus, cûpa or cuppa, pûpa or puppa, stûpa or stuppa, scîroma or sciroma, stlûpus or stloppus or scloppus, colûphium or colli-phium, which should invariably retain the double consonant, since it is by position alone that they are long, by the consonant, and not by the vowel, reduplication.

60. Syllables indifferently spelled with a single vowel, or a diphthong, are long; as tûda or tæda, prûlum or prælum, which latter orthography, the most expressive of the vowel quantity, it is better to retain.

61. Vowels derived from *η*, *α*, *ε*, *ι*, *ω*, are long, as hîrûus, Sîrius, mûsa, from *ἥρως*, *σῆρις*, *μοῦσα*.

Note.—Many of these are already comprised under the preceding rules; the principal words referrible alone to this rule, are cûlon, cratûra, hîpar, hîros, lecythus, lethum, lichen, ôde, rhêtor, spûlæum, spû-lunca, thûsauros, thûrax, thûoria. To these we may add near 200 words of very rare occurrence, chiefly signifying plants, herbs, stones, minerals, &c. &c. as anthêdon, asclepias, asplênion, &c. Of these we would here insert our manuscript list, but since they are principally confined to such authors as Pliny, Celsus, Vitruvius, and Frontinus, they are matter rather of occasional reference, than of any grammatical rule.

62. Some words alike in orthography, differ in quantity only according to their signification; as

1. Pûpulus arbor
2. Est; notat et pûpulus
3. Plebem. Sic mûlus est pro
4. Pravo; gignit item mûlum.
5. Navis mûlus; mûlina mûlus,
6. Stîrpe unâ produci possunt. Mûla genam vult;
7. Mûla poma. Et pûlus
8. Faciens pûludis; est ferè
9. Stagnum lacûve; at non tamen sic
10. Pûlus notans sûdem. Nitor, nitenisque,
11. Niten; creatque nitor et nitens scûbs.
12. Protellure solum; non ita solum aut
13. Ab eo solum. Plaga notione
14. Retis vel ôre corripitur; licet
15. Verberis aut vice vulneris, tu
16. Extendas ita plagam. Pûla sic in globuli lûco
17. Contrahiturque; mole
18. Denotata, porrigè pilam; notat atque pilus
19. Aciei feriem mûllique;
20. Ea pilum quoque, mûllamque terit. Sin
21. Vice crinis pilus est; atque pilo dat: pilo
22. Significat fûrari, non fûrere. Et notat cûmire
23. Cæsarîem gerere; sed cûmire ornare est cûmam.
24. Colûre aquam nos dicimus; || sed colere arvâ, fûna.

Note.

Note.—The above verses not only furnish the words relating to rule 62, but also, to unite two objects in one, they at the same time afford a specimen of all the Horatian metre, which, to the classical student, may prove a useful compendium. It is, probably, only the second production of the kind in print. The first is quoted by the two editors of Horace, Cruquius and Baxter, and, had its subject been as eligible as the design, the present would have been superseded. For a definition of the Horatian metres composing this specimen, the reader may consult Lyne's Latin Primer, (edit. 4th) page 246, or VERIFICATION, in the sequel of this work. The following, however, are the Horatian metres, as exemplified in the above lines: 1. An Adonic; 2. A dactylic penthemimer; 3. A Pherecratian tripod; 4. A Glyconic choriambic; 5. Dactylic tetrameter; 6. An hexameter; 7. Iambic dimeter accephalous; 8. Iambic dimeter; 9. Iambic dimeter hypercatalectic; 10. Iambic trimeter catalectic; 11. Iambic trimeter; 12. An alexandrin; 13. A Sapphic hendecasyllabic; 14. A great Alcaic; 15. A small Alcaic; 16. Alcaic choriambic; 17. Choriambic dimeter; 18. Epichoriambic tetrameter; 19. Ionic à minori trimeter; 20. Sapphic lonic; 21. Ionic à minori tetrameter; 22. Dactylic heptameter; 23. First elegiac Archilochian; 24. Second elegiac Archilochian. The remaining words alluded to by rule 62, are comprised by the following hexameters.

25. Ad mediam noctem sœrum producere possis;
26. Datque sœrum tibi lac. Sûpire facit sœpor omnes.
27. Ac loboles perniciis, uti perneciter, eandem
28. Deductam vocalem extendunt. Perque nœcare
29. Perneciem proletem tibi dant. Iœcer acutum
30. Denotat; arborem œier vult; atque corripitur
31. Amborum loboles. Prœcœres, faciens prœcœrum, sit
32. Pro magnitibus; et cœlo prœcœrus. Et lœbor
33. Lœbi; sed lobis facta lœbore; lœbora, lœbare.
34. Rurfus, lœtœre uti lœqueant tibi, dîcere possis
35. Ut liceat proferre, metalla lœquare, lœquorem,
36. Lœqui. Lœtœum et in lœtœo lœto olêscere lœtum.
37. Idem eœdem, necnon idem, et in texto ht eœdem.
38. Lœteri uti sint verd lœberi, iis nihil extat
39. Utiliûs, quàm ut sanctus lœber hîcœ lœgendus
40. Sit, tunc his lœbertatem lœgatis: ididem
41. Ut mœres mœi possint solimque salutem
42. Eternamque mœruri; quâ, mœrû perniciosa
43. Valde est; utque ita mœri mœrenturque revera,
44. Dîcœnt. Dœnique hæc, dîco, mentique dîcandû.

General Rule.

63. A vowel before a single consonant, not affected by any preceding or following rule, is short; as sapiô, silîqua, grâcîlitas.

1. Attamen excipias hæc pracula, cœu, crocodîlus,
2. Alea, fûligo, pirâta, abstîmius, ôlim,
3. Area, sôlennique vœnêscis, ilicet, îco,
4. Hibernus mâcûtinusque salârica, nôdus,
5. Citellæ, bâlenaque, eœram, lîlia, gluten,
6. Mâturus, limax, capitôlium, anônymus, îlia,
7. Adduntur nîdor, vendêmia, flâgito, velox
8. Tîbia, tibicenque acadêmia, filula, pâla,
9. Grâdivus, Mâvors, Sâturmus, Jûpiter, Iris,
10. Python, lîdola ethnica, vel crepitacula. Rurfus
11. Âla, repâgula, sœmi, sœmis, eœpia, fîlum,
12. Viburnum, contâmîno et âles crâpula, tâlus,
13. Vitupero, niausôleum, mágalia, râpum,
14. Câligo, sûgillo, mûlus, mûtus, idus,
15. Mœtîri, bâlîstæque, felix, dœnuo, quâlus,
16. Solicito, pridem, sic pridie, et simia, sœpes,
17. Lâmina, tœmêtum, irrîtare, monêdula, mûgil,
18. Rhinoceros, dûdum, nâsus, prævâricor, adde
19. Vâricor; invîto cœu vîto, sôlea, dœnce,
20. Jûnipernique. Nec ôtia dantque nêgôtia; solers
21. Eurîus, grâtus, pœnûria, pœcula, rhêda,
22. Ociûs lîadæm, fîli perdlîce Hômêri;
23. Cœleus, et vibex, imbricillique. Dat hîlum,
24. Progeniemque nihil. Quâm sæpe, heu! ducere possint
25. Nûgaces, nûgas, tricaque. Cânôpus, usilus,
26. Glûcîre ac vœcors, sôcors, exdîctus, ætr,
27. Aëris ac âio quoque âio; vipera, erêber,
28. Vâpulo; et audîre atque ôb, obêdîre efficiuntque
29. Adduntur gnômon, vâgîre, bonâsus, omâsum,
30. Dividere, ac îdiôta, hînâpis, trâgula, jûgis;
31. Corripunturque hæc mæceo, mæcer; exprime prolem
32. Mæcero: et adde vœco, quod vœcem, vœciferoque

33. Vocalem variat, formatque vocabula. Plæco;
34. Plæcatus plæco plæcidus, plæcabilis, unâ
35. No nâvi nôtum nâto, uti nôtum nôta, vâdo
36. Atque vâdum, nûbo unâ pronûba sunt varianda.
37. Sic oblvîscor et pecûlia, silus, ædon,
38. Fastidire hâlec, marsûpia, fabula, phrâsis,
39. Sibilo anicetum îqualere et ephêbus, iûlus,
40. Glôcîre, ôccamus, pipire, factîr, tûber,
41. Et cœlum, lbum, conchylia, frâgula, tâbum
42. Faux dat præsœo, sic vespertilio, pûpus,
43. Sœculum et adduntur sûles et sœria râsis
44. Râvire ac udus mûgîre et bâlia, nâpus
45. Brâchia fœria anêtha et anôdina glôria thôrax
46. Nûdra cœlorum considêra, opes meliores
47. Terrenis necnon desudêra, omite minora.

Note.—1. To confine the preceding rules to limits as short as possible, 1st, the preceding rules and their exceptions relate only to words of pure or Augustan Latin. 2. Some terms of very rare occurrence, chiefly the names of plants, herbs, stones, fossils, &c. near 300 in number, are omitted, as matters of occasional reference, rather than of constant attention or grammatical rule.

2. We have now, after four consecutive analyses of the language, for the more complete information of the student, accomplished a task, perhaps never achieved before, nor, so far as we are acquainted, offered to the public, in any prosodial system. And we can venture to affirm, that any person well acquainted with common prosody, and the rules of this section, will not, within the precincts of Augustan Latin, find a single word, except the few of rare and unfrequent occurrence mentioned above, whose quantity is not regulated or accounted for by the rules now given. Thus, for the first time, we have reduced that, the majority of Latin quantity, by all preceding prosodians referred to a course of observation and practice alone, to a regular classification and system. Would our limits permit, we would here, for the sake of exemplification, take the words comprised by any letter of the alphabet, and account for the quantity of each by the principles and criteria we have here considered.
3. It is almost necessary here to add, that the quantities of syllables are marked with very frequent inaccuracy in most of our common dictionaries. The poets are the only satisfactory test.

SECTION III.—On final Syllables.

1. A final, in words declined by cafes, is short; as famâ, regnâ, lampadâ.

Anchorâ de prora jacitur; stant littore puppes.

Virg.

1. Except the ablative singular of the first declension; as hâc musâ, hoc Ænêi.

2. The vocative singular from Greek nouns in *as*; as O Pallâ, O Atlâ.

1. Prospiciens, summâ placidum caput extulit undâ.

Virg.

2. Non hæc, O Pallâ, dederas promissâ parenti.

Virg.

2. A final, in words not declined by cafes, is long; as amâ, ultrâ, prætereâ.

1. Littus amâ et lævas stringat sine palmula cautes.

Virg.

2. Intercâ magno mihi eri murmure pontum.

Virg.

1. Except itâ and ejâ short, and postea common.

2. Quia is generally short, but since Phædrus lengthens it, we may pronounce it to be common.

3. Some prosodians quote puta, with the *a* short, from Persius, 4. 9. But the best editions have puta, a reading evidently preferable, in point both of sense and grammar.

4. Though numerals in *ginta* are sometimes found short, approved authors lengthen the *a*; yet it may be well to recollect, that the Greek termination KONTA, whence the Latin *ginta* is evidently borrowed, has the final vowel short; as

Τοις δ' ἀνα πσσαρα KONTA μελανανηϊς ἴποντο.

Hom.

[See many other instances in Iliad B.]

1. . . Ferret ad aurigere caput arboris, ejâ, per ipsum.

Val. Flac.

2. Tum sic affatur regem, atque itâ turbidus infit.

Virg.

3. Si auctoritatem postea defugeris.

Plaut.

4. Postea mirabar, cur non sine litibus esset.

Ovid.

5. Haud, (equidem credo,) quâ sit divinitus illis.

Virg.

6. Ego primum tollo, nominor quâ leo.

Phædr.

7. Stragintâ teras cum limina niane fenat.

Mart.

8. Trigintâ toto mala sunt epigrammata libro.

Mart.

QUANTITY.

3. E final is short; as natē, patrē, currē, nempē, antē.

Incipē, parvū puer, risu cognoscere matrem. Virg.

1. Except that final E in all cases of the ¹ first and ² fifth declension, is long; as Calliopē, Tydidē, Anchisē, fidē; also ³ famē, originally of the fifth. Thus also, *rē, diē*, and their ³ compounds *quarē, hodiē, pridē, postridē, quotidē*.

2. Also in ⁴ all nouns wanting the singular; as *cetē, melē, tempē, pelagē*, Greek neuters plural.

3. The second person singular of the imperative of the ⁵ second conjugation, has the E long; as *docē, monē*; but ⁶ cave, ⁷ vale, ⁸ vide ⁹, ¹⁰ responde ¹¹, and ¹² salve ¹³, have e common.

4. ¹⁴ Monosyllables ending in E are long; as *ē, mē, tē, sē, nē* (left or not) except ¹⁵ enclitics and syllabic adjectives; as *quē, nē, vē, plē, cē, tē*; as *nequē, ququē, suaptē, hujuscē, tutē, &c.*

5. ¹⁶ Adverbs in e coming from nouns of the second declension are long; as *placidē, pulchrē, valdē* or *validē, &c.* Except ¹⁷ *benē, malē*, ¹⁸ *supernē*, ¹⁹ *infernē*, *magē*.

6. ²⁰ *Fermē*, ²¹ *ferē*, and ²² *ohē*, have e long.

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|---|---------|
| 1. Hanc tua <i>Penelopē</i> lento tibi mittit, Ulyssē. | Ovid. |
| 2. Et quamquam fœvit pariter <i>rabieque, famēque</i> . | Ovid. |
| 3. Quæ mens est <i>hodiē</i> , cur eadem non puero fuit? | Hor. |
| 4. At <i>pelagē</i> multa, et late fustrata videmus. | Lucret. |
| 5. Vade, <i>valē</i> , cave ne titubes, mandataque frangas. | Hor. |
| 6. Idque, quod ignoti faciunt, <i>valē</i> dicere saltem. | Ovid. |
| 7. <i>Responde</i> , quibus amissas reparare queam res. | Hor. |
| 8. Si quando veniet? dicet; <i>responde</i> , poeta. | Mart. |
| 9. Quid sis nata <i>vide</i> , nisi te quoque decipis ipsam. | Ovid. |
| 10. <i>Vide</i> , ne dolone collum compungam tibi. | Phædr. |
| [See also Perf. 1. 108.] | |
| 11. Lector <i>salvē</i> . Taces, dissimulasque? Vale. | Mart. |
| 12. <i>Salvē</i> , Pæoniæ largitor nobilis undæ. | Claud. |
| 13. Vera, inquit; <i>nequē</i> me Argolica dē gente negabo. | Virg. |
| 14. <i>Præcipuē</i> , cum jam hic trabibus contextus acernis. | Virg. |
| 15. Nil <i>benē</i> cum facias, facis attamen omnia belle. | Mart. |
| 16. Tecta <i>supernē</i> timent: metuunt <i>infernē</i> cavernas. | Lucret. |
| 17. Mobilis et varia est <i>fermē</i> natura malorum. | Juven. |
| 18. Jamque <i>ferē</i> sicco, subductæ littore puppes. | Virg. |
| 19. Importunus amat laudari? donec <i>ohē</i> ! jam. | Hor. |

4. I final is long; as domini, classī, fieri, doceri, audi, i, fili.

Olli respondit rex Albū Longū.

Enn.

1. Except the i of Greek vocatives; as *Alexī, Amaryllī, Thetī, Parī, Daphnī*; but *Simōi*, or such as belong to nouns having *entos* in the genitive, are long.

2. Greek datives singular of the third declension, from nouns increasing, are varied. *Minoidī* and *Tethyī* in Catullus, and *Palladī* in Statius, are short.* *Thetidi* in Catullus, and *Paridi* and *Tyndaridi* in Propertius, are long; but Greek datives formed by contraction are always long; as *Demostheni*, *metamorphosi*; also those which come from the first declension in Greek; as *Orestī, Euripidī*.

3. Neuters in i are also short; as *gummī, melī, sinapī*.

4. Datives and ablatives plural of Greek nouns in *i* (fin before a vowel) are short; as *heroisī, Troasī*.

5. *Mihi, tibi, sibi* are common. Also *ibi, nisi, ubi* and *quasi*; but these last are more frequently short.

*Note.—These may be long by poetic licence, or by position; for the i of Greek cases is naturally short. *Orphēi* may be considered as a dactyl in Virgil. Eccl. 4. 57; and by synæresis it is a spondee in the *Georgics*, 4. 535 and 553.

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| 1. O crudelis <i>Alexī</i> , nihil mea carmina curas. | Virg. |
| 2. <i>Palladī</i> littoreæ celebrabat Scyros honorem. | Stat. |
| 3. <i>Troasī</i> invideo, quæ si lacrymosa fuorum. | Ovid. |
| 4. Non unquam gravis ære domum <i>mihī</i> dextra redibat. | Virg. |
| 5. Extremum hunc, <i>Arcthusa, mihī</i> concede laborem. | Virg. |

5. O final is common; as quando, Cato, leo, ambo, octo, amo, doceto.

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| 1. Arma amens <i>capio</i> , nec sat rationis in armis. | Virg. |
| 2. Non <i>amō</i> te, <i>fabidi</i> ; nec possum dicere quare. | Mart. |

1. Except ¹ monosyllables, which are long; as *ō, prō, dō, stō*, and *prōh*, h not being accounted as a letter.

2. ² Greek feminines ending in o are long; as *Didō, Sapphō, Clīo*.

3. O final in ³ datives and ablatives of the second declension, is long; as *formō*; to which add another ablative, as *ergō*, for the sake of, ergo therefore belonging to the rule.

4. Also ⁴ Greek cases, written in the original with omega; as *Androgeō, Athō*.

5. ⁵ Adverbs formed from nouns have the final o long; as *subitō, meritō, multō*; and *illō, quō, eō*, and their compounds. Also *citrō, intrō, retrō, ultrō*. But the o following are sometimes found short, *denuō, idcirco, serō, profectō, postremō*, the conjunction ¹⁰ *verō*, ¹¹ *porrō*, to which some add *sedulō, crebrō*, and *mutuō*. ¹² *Modō* (used adverbially,) and its compounds are short; as *quomodō, dummodō, postmodō*.

6. Though the final o of verbs, occasionally by writers of a ¹ secondary class, and more rarely by those of the ² Augustan age, has been made sometimes short, yet its derivation from the Greek omega, and the more general practice of the principal poets, make it long: the o of *scio*, ⁶ *nescio*, *puto*, *cito*, and of the imperative *cedo*, only, are generally short.

7. The gerund in *do*, in reality, being nothing else than the dative or ablative of the second declension, is, accordingly, by all authors of the Augustan age, made long: the ¹ exceptions to this rule are very few, and only by writers of an inferior class.

8. ¹³ *Ambo, duo, imo, illico, ego*, generally shorten o final.

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| 1. <i>Prō</i> molli violā, <i>prō</i> <i>purpureō</i> narcisso. | Virg. |
| 2. <i>Clitūque</i> , et <i>Beroē</i> foror, <i>oceanides</i> ambæ. | Virg. |
| 3. In foribus letum <i>Androgeō</i> : tum pendere pœnas. | Virg. |
| 4. Adde, quod iste tuus, tam <i>rarū</i> prælia passus. | Ovid. |
| 5. Uſque <i>aleſine</i> times, quem tu facis ipſe timendum? | Lucret. |
| 6. <i>Idcirco</i> gemellum vocitarunt choriambon. | Terent. |
| 7. <i>Illeircō</i> certis dimenſum partibus orbem. | Virg. |
| 8. Imperium tibi <i>ſerō</i> datum: victoria velox. | Claud. |
| 9. Et Scauros, et Fabricios; <i>poſtremō</i> ſeveros. | Juven. |
| 10. Quod petimus: ſin <i>verō</i> preces et dicta ſuperbus. | Val. Flac. |
| 11. Veſter <i>porrō</i> labor ſæcundior hiſtoriarum. | Juven. |
| 12. Hic inter denſas coryſos <i>molō</i> namque gemellos. | Virg. |
| 13. Horrida Romuleum certamina pangō duellum. | Enn. |
| 14. <i>Prandē</i> , <i>prō</i> , cauo, ludo, <i>lavō</i> , <i>cenō</i> , quietſco. | Mart. |
| 15. <i>Dixerō</i> quid ſi forte joculoſus, hoc mihi juris. | Hor. |
| 16. Sic ubi <i>neſciō</i> quis Lycia de gente virorum. | Ovid. |
| 17. Quæ noſti, <i>meditantō</i> velis inoleſcere menti. | Auſon. |
| 18. Præterea <i>duō</i> nec tutā mihi valle reperti. | Virg. |

6. U final is long; as vultū, cornū, Panthū, dictū, diū.

Quo res summa loco, Panthū? quam prendimus arcem. Virg.

1. Except ¹ *indū* for in, and ² *nenū* for non, both used by Lucretius, the former likewise by others, in composition, as *indūperator*, have the u short.

2. Also the ū before the elided s; as *nunciū, plenū*, for *nuncius, plenus*.

QUANTITY.

1. *Indū* manu validas potis est moderanter habenas. Lucret.
2. *Nenū* quæunt rapidi contra conflare leones. Lucret.
3. Vicinus O focii, et magnam *pugnāvimū* pugnam. Enn.

7. Y final is short; as *Molŷ*, *Tiplŷ*, *Chelŷ*, *Tethŷ*.

Molŷ vocant superi.

Ovid.

Except when *y* is a contraction, as in *Tethy*, instead of *Tethyi*, the dative, it is long by the general rule for crasis.

Quam *Tethŷ* longinqua dies, Glaucoque repostam. Val. Flac.

8. Latin words ending in B shorten the preceding vowel; foreign words lengthen it, as *āb*, *ōb*, *Jōb*, *Jacōb*.

Magnus *āb* integro sæclorum nascitur ordo. Virg.

9. Final C lengthens the preceding vowel; as *āc*, *sic*, *hic*, (adverb), *dūc*, *illūc*, &c.

Sic oculos, *sic* ille manus, *sic* ora ferebat. Virg.

1. Except that *nec* and *donec* are short, as also the imperative *fac*.*

2. *Hic* and *hoc* of the nominative and accusative, are common.

* Two passages quoted from incorrect copies of Ovid, to prove *fac* long, in better editions appear *facito* and *face*; so that, according to the opinion of Alvarez, it is safer to consider *fac* as short.

1. Parve, *nēc* invideo, sine me, liber ibis in urbem. Ovid.
2. *Doncē* eris felix, multos numerabis amicos. Ovid.
3. Signa rarius, aut semel *fac* illud. Mart.
4. Hic vir, *hic* est, tibi quem promitti sæpius audis. Virg.
5. Hic gladio fidens, *hic* acer et arduus hasta. Virg.

10. Final D, in Latin words, shortens the preceding vowel; in foreign words it lengthens it; as *quid*, *ād*, *apūd*, *illūd*, *sēd*, *David*.

Ipse docet *quid* agam. Fas est et *ēb* hoste doceri. Ovid.

11. Final L shortens the preceding vowel: as *mēl*, *fēl*, *pōl*, *fiml*, *feml*, *nihil*, *constl*.

Innocui veniant: *prociū* hinc, *prociū* impius esto. Ovid.

1. Except that Hebrew words are generally long; as *Daniel*, *Nabāl*, *Saūl*.

2. *Sāl*, *fōl*, and *nīl*, are long.

1. Non *sāl*, oxyporumve caseusve. Stat.
2. Omnia sub pedibus, quā *sōl* utrumque recurrens. Virg.
3. *Nīl* opis externæ cupiens, *nū* indiga laudis. Claud.

12. Final M was, anciently, short, and was not, as now, elided when followed by a vowel.

Insignita ferē tam millia *militūm* octo. Enn.

It is short in *circūm*, in composition with words beginning with a vowel, as *circūmeo*, *circūmago*.

1. Cujus non hederæ *circūmiere* caput. Propert.
2. Quo te *circūmagas*? quæ prima aut ultima ponas? Juven.

13. Final N lengthens the preceding vowel; as *ēn*, *splēn*, *quin*, *nōn*, *sīn*, *rēn*, *Pān*, *Salamīn*, *Oriōn*, *Titān*.

Mersit et ardentes *Oriōn* aureus ignes. Manil.

1. Except nouns ending in *en*, which have *inis*, short, in the genitive; as *carmēn-inis*, *tegmēn-inis*.

2. Also nouns in *on* of the singular number, from the Greek *o* (omicron), and which, in Latin, are of the second declension; as *Ilīōn*, *Pylōn*.

3. N is short in the accusatives of Greek nouns, having the final syllable of their nominative short; as *Majān*, *Æginān*, *Orpheōn*, *Alexīn*, *Ibīn*, *Chelŷn*, *Itŷn*.

4. Also *ān*, *īn*, *forsān*, *forſitān*, *tamēn*, *attamēn*, *veruntamēn*, *vidēn*, *fatīn*, have *n* short.

1. Addunt et titulum; titulus breve *carmēn* habebat. Ovid.
2. Laudabunt alii claram *Rhōdōn*, aut *Mitylenēn*. Hor.
3. Tantæque nox animi est, *tŷn* huc arceſſite, dixit. Ovid.
4. Mittite; *forsēn* et hæc olim meminisse juvabit. Virg.
5. *Forſitān* et, Priami fuerint quæ fata, requiras. Virg.
6. Educet. *Vidēn* ut geminæ ſient vertice criſtæ. Virg.

14. Final R shortens the preceding vowel; as *vŷr*, *puēr*, *tēr*, *timōr*, *calcār*, *Hamilcār*, *amamūr*, *audiuntūr*.

Tum *patēr* omnipotens miſſo perſegit Olympum. Ovid.

1. Except *eris*, long, in the genitive; as *cratēr*, *ſtatēr*, *vēr*, *Recimēr*, *Iber-eris*; but *Celtiber*, the compound of *Iber*, has the penultimate common.

2. Also *aēr* and *athēr*, though they increase short in the genitive.

3. And *fār*, *lār*, *nār*, *cūr*, *fūr*, and *pār*, with its ¹² compounds, *compār*, *impār*, *diſpār*.

1. *Cratēr* auratis ſurgit celatus ab aſtris. Manil.
2. *Vēr* erat æternum, placidique tepentibus auris. Ovid.
3. Si tibi durus *Ibēr*, aut ſi tibi terga deoſſet. Lucan.
4. Nunc *Celtibēr* in *Celtibēria* terrā. Catul.
5. Ducit ad auriferas quod me ſalo *Celtibēr* oras. Mart.
6. Inde mare, inde *aēr*, inde *athēr* ignifer ipſe. Lucret.
7. *Fūr* erat, et puri lucida mŷca ſalis. Ovid.
8. Exagitant et *Lār*, et turba Diania fures. Ovid.
9. Sulſurēā *Nār* albus aquā, fonteſque Velini. Virg.
10. Multa quidem dixi, *cūr* excuſatus abirem. Hor.
11. Callidus effraſta nummos *fūr* auferet urcā. Mart.
12. Ludere *pār*, *impār*, equitare in arundine longa. Hor.

Note.—*Cor* long is attributed to Ovid, but the line in which it is said to be thus found, is read differently in corrected editions; the same remark is applicable to *vir*; as

1. Molle meum levibusque *cōr* est violabile telis. Ovid.
2. De grege nunc tibi *vīr*, nunc de grege natus habendus. Ovid.

Thus corrected, *vir* is long merely by position.

15. Words ending in AS, lengthen the final syllable; as *mās*, *vās*, *crās*, *fās*, *amās*, *farās*, *pietās*, *Thomās*, *Mufas*.

Hūs autem *terrās*, Italiq; hanc littoris oram— Virg.

1. Greek nouns in *as* are short, which make the genitive in *ados* or *adis*, as *Arcas*, *Pallas*, *Lampas*, *Ilias*; to which add the noun *Anās*, and Latin nouns in *as*, formed after the manner of Greek patronymics; as *Appiās*.

2. Also the final *as* of Greek accusatives plural of the third declension is short; as *craterās*, *lampadās*, *Troās*, *Cyclopās*, *herōas*, *heroidās*, *Hēctōrās*, &c.

1. Bellica *Pallās* adeſt, et protegit ægide fratrem. Ovid.
2. Et piētis *anūs* enovata penus. Petron.
3. *Appiās* expreſſis aëra pulsat aquis. Ovid.
4. *Naiādās* his venam, quæ nunquam aſcere poſſet— Ovid.

16. Words ending in ES lengthen that syllable; as *rēs*, *ſpēs*, *vulpēs*, *quiēs*, *hærēs*, *efſēs*, *Anchiſēs*, *totiēs*, *lo-cuplēs*.

Vulpēs ad cœnam dicitur ciconiam. Phædr.

Phædr.

1. The nouns and vocatives plural of Greek nouns increasing (not in *es*) short in the singular, are short; as *Amazonēs*, *Arcadēs*, *Delphinēs*, *Naiadēs*, *Gryphēs*, *Phrygēs*.

2. To which may be added Greek vocatives singular in *es*, coming from nominatives in *es*, not formed from *eus* of the Doric dialect, and having their genitive in *es*; as *Demōſthenēs*, *Socratēs*.

QUANTITY.

3. * *Es*, in the present tense of *sum*, and its ³ compounds, is short; as *adēs*, *abēs*, *prodēs*, *potēs*, &c.; and in the preposition *penēs*.

4. Latin nouns of the third declension, in *es*, increasing short in the genitive, are short in the final syllable; as *hebēs*, *alēs*, *pedēs*, *lmēs*, *obsēs*. But *es* is long in these following; *Cerēs*, *pariēs*, *ariēs*, *abiēs*, *pēs*, and its ³ compounds, as *bipēs*, *tripēs*, *alipēs*, *sonipēs*; to which some add *præpēs*, a derivative of *præpeto*.

1. *Troadēs*; et patriæ fumantia tecta reliquunt.
2. Quisquis es, amissos hinc jam obliviscere Graios.
3. Nunc adēs O cæptis, flava Minerva, meis.
4. Vivitur ex raptō; non hospis ab hospite tutus.
5. Flava *Cerēs* alto pequicquam spectat Olympo.
6. Creditur: ipse *ariēs* etiam nunc velleri siccatur.
7. Desuper Aurigæ dexter pēs imminet astro.
8. Stat *sonipēs*, et fræna ferocis ipumantia mandat.

Ovid.
Virg.
Ovid.
Ovid.
Virg.
Virg.
Manil.
Virg.

*Note.—1. Though *es*, in the present tense of *sum* and its compounds is short, it is not in any other tense, nor in the final syllable of *effēs*, (as has been asserted,) as

Possēs in tanto vivere flagitio?
Effēs loniū tacta puella maris.

Propert.
Propert.

2. Whenever *paries*, *aries*, and *abies* are found long, there happens to be a caesura; and perhaps *Ceres* and *pes* are long by dialeto: *Aufonius* shortens *bipes* and *triges*; and *Probus* observes that *alipes* and *sonipes* are likewise short: though the contrary appears in *Virgil*, *Lucan*, and *Horace*, yet some of the above-mentioned words could not be introduced into heroic verse without the influence of a figure to lengthen their final syllable. *Præpes*, which comes not from *pes*, but from *πρᾶπτος*, is short in *Virgil*. (*Æn.* 5. 254.) *Tigrēs*, ascribed to *Ovid*, is, by the best critics, rejected.

17. *IS* final is short; as *bīs*, *īs*, *quīs*, *cīs*, *magīs*, *turrīs*, *militīs*, *creditīs*, *Thetīs*.

Tum tīs ad occasum, *bis se* convertit ad ortum. Ovid.

1. Except plural cases in *īs*; as *nobīs*, *vobīs*, (² *quīs* for *quibus*), *musīs*; the plural accusatives ³ *omnīs*, ⁴ *urbīs*, &c.

2. The nominative in *īs* is long, when the ³ genitive ends in *itis*, *inis*, or *entīs* long; as *lis*, *Samnīs*, *Salamis*, *Simoīs*.

3. *Is* is long in the adverbs ² *gratis* and *forīs*; in the noun *glīs*, and in *vīs*, whether noun or ⁴ verb.

4. All ⁶ second persons singular in *īs* are long; when the second persons plural have *itis* long; as *cīs*, *fīs*, *vis*, *is*, *abīs*, *audīs*, *velīs*, *nolīs*, *posīs*, &c.

5. ¹⁰ *Ris* of the perfect is commonly considered short, of the ¹¹ future ², common; so are the penultimates of *ausīs* and *faxis*: *ris* and *ritis* of ¹³ *ero* and *potero* are more frequently short.

1. Inducenda rota est: das nobīs utile munus
2. Quis ante ora patrum Trojæ sub mœnibus altis.
3. Non omnis arbuta juvant, humilesque myricæ.
4. Adde tot egregias urbes, operumque laborem.
5. Sed tīs est mœni de tribus capellis.
6. Nescīs, heu! nescīs dominæ fastidia Romæ.
7. Ignea convexi rīs et sine pondere cæli.
8. Si vīs esse aliquis. Probitas laudatur et alget.
9. Gratis anhelans, multa agendo, nil agens.
10. Dixeris egregie notum si callida verbum.
11. Quas gentes itālum, aut quas non oraveris urbes.
12. Da mihi te placidum; dederis in carmine vires.
13. Fortunata puer, tu nunc rīs alter ab illo.

Mart.
Virg.
Virg.
Virg.
Mart.
Mart.
Ovid.
Juven.
Phædr.
Hor.
Virg.
Ovid.
Virg.

18. *OS* final is long; as *rōs*, *vōs*, *nōs*, *mōs*, *fiōs*, *trōs*, *arbōs*, *honōs*, *custōs*, *nepōs*.

Os homini sublime dedit, cælumque tueri. Ovid.

1. Except ¹ Greek genitives in *os*; as *Arcadōs*, *Te-thyōs*, *Tereōs*, *Orpheōs*.

2. Also ² *compōs*, *impōs*, and ³ *ōs-offis*, with its compounds *exōs*, have the final syllable short.

3. ⁴ Greek nominatives and vocatives of the second declension have *os* short; as *Clarōs*, *Tenedos*, *Leibōs*, *Atropōs*. But those nouns of the Attic dialect, having their genitives in *omega*, are long, as *Androgeōs*, *Athōs*: also nouns of the same dialect, which have changed *laōs* (*λαός*) into *leas* (*λαίς*), as *Peneleōs*, *Meneleōs*.

4. Greek neuters in *os* are short; as *Argōs*, *epōs*, *chaōs*, *melos*.

1. Alta jacet vasti super ora *Typhoēs* *Ætna*.
2. Insequere, et voti postmodo *compōs* eris.
3. *Exōs* et exanguis tumidos perfluat artus.
4. Tum, cum tristis erat, defensa est *lōs* armis.
5. Quantus *Athōs*, aut quantus *Eryx*, aut ipse carufcis.
6. Et *Chaōs* et *Phlegethon*, loca nocte silentia late—

Ovid.
Ovid.
Lucræ.
Ovid.
Virg.
Virg.

19. *US* final is short; as *tenūs*, *littūs*, *penitūs*, *intūs*, *Ambobūs*, *Montibūs*, *Amamūs*.

Lucipe: pascentes servabit *Tityrūs* hædos. Virg.

1. Except ¹ monosyllables in *us*; as *grūs*, *plūs*, *rūs*, *thūs*, *jūs*.

2. Also the genitives of feminine nouns in *o*; as *Clīūs*, *Sapphūs*, *Mantūs*.

3. Genitives singular, and nominatives, accusatives, and vocatives plural of the fourth declension, (all being contracted,) have *us* long; as *fructūs*, *manūs*.

4. Also nouns increasing long in the genitive; as *palūs-ūdis*, *virtūs-ūtis*, *tellūs-ūris*, *Opūs-ūntis*.

5. *Us* is long in the ⁵ compounds of *πους*, (forming the genitive in *podis* or *podos*), as *Tripūs*, *Melampūs*, *Ædipūs*, *Polypūs*.

6. Also ⁶ those nouns which have *u* in their vocative; as *Panthūs*, *O Panthu*.

7. Finally, ⁷ *ἱππους* has the final syllable long.

1. Romæ nūs optas, absente rusticus urbem.
2. *Didūs* atque suum miscet sanguine linguam.
3. Pars secreta domūs ebore et testudine culta—
4. Ridet ager; neque adhuc *virtūs* in frondibus ulla est.
5. Hic *Ædipūs* *Ægea* tranabit freta.
6. *Panthūs* *Othryades*, arcis *Phæbique* sacerdos.
7. Et cælo et terris venerandum nomen *Jesūs*.

Hor.
Varro.
Ovid.
Ovid.
Seneca.
Virg.

20. *YS* final is short; as *Capys*, *chelys*, *chlamys*.

At Capys, et quorum melior sententia menti. Virg.

Except nouns which form the nominative in *yn* also; as *Gortys*, *Phorcys*. To these add contracted plurals; as *Erynnys*, for *Erinnyes*, or *Erinnyas*.

21. Final *T* shortens the preceding vowel; as *capūt*, *amāt*.

Verum hæc tantum alias inter; capūt extulit urbes. Virg.

Except when final *t* is long by crasis: as *redit* for *rediit* or *redivit*.

Magnus civis obit et formidatus *Othoni*. Juven.

22. The last syllable of every verse is considered common; that is, if the syllable be naturally long, it may be accounted short; or, if it suit the verse, *vice versa*.

Gens inimica mihi Tyrrhenum navigat æquor. Virg.
Crescit occulto velut arbor ævō. Hor.

Note.—1. In the first of these examples, *or*, naturally short, forms the second syllable of a spondee; in the last, a Sapphic verse, the word *ævō*, which is naturally a spondee, forms a trochee.

2. "The grammarians that displease Dr. Clarke, (see Clarke's *Homæ*, *Iliad* A. v. 54.) by saying that the last syllable of a verse is common, only mean, that the local quantity supercedes the natural quantity of the syllable."

For the last principal head of prosody; see VERSIFICATION.

QUAN-TSOM, in *Geography*, a town of China, of the third rank, in Pe-tche-li; 32 miles S. of Chunte.

QUANTUM

QUANTUM MERUIT, called also an *assumpsit*, in *Law*, an action upon the case, grounded upon a necessity to pay a man for doing any thing so much as it deserves or merits.

This valuation of his trouble is submitted to the determination of a jury; who will assess such a sum in damages as they think he really merited.

QUANTUM VALEBAT, or an implied *assumpsit*, is where goods and wares sold, are delivered by a tradesman at no certain price, or to be paid for them as much as they are worth in general; then *quantum valebat*, or an action on the case, lies, and the plaintiff is to aver them to be worth so much; so where the law obliges one to furnish another with goods or provisions, as an inn-keeper his guests, &c.

QUANTZ, JOHN JOACHIM, in *Biography*, chamber musician to Frederic II. king of Prussia, to whom he had been flute-master before his accession to the crown. Quantz was born at Obersehlen, a village in the electorate of Hanover, in 1697. His father, who was a blacksmith, obliged him to work at the anvil before he was nine years old; which must have afforded him an early opportunity of making the famous Pythagorean experiment, mentioned by Jamblichus (de Vit. Pythag.), and by all the musical writers of antiquity. Indeed, the ear of our young Ardalus had been already formed, in his excursions with his brother, a village musician, who used to play about the country on holydays and festivals, whom he accompanied upon these occasions, on the base-viol, when but eight years old, and without knowing a note of music; but this performance, bad as it was, pleased him so much, that he determined to choose music for his profession; though his father, who died when he was only ten years of age, recommended to him, on his death-bed, to continue in the honourable profession of his ancestors.

Quantz, after losing his father, had no other friends to depend upon for counsel and protection, than two uncles, who lived at Merseburg in Saxony; and these, sending for him, gave him the choice of their several professions, the one being a taylor, and the other a *kunstpfeifer*, or town-wait.

Upon this occasion, the passion for music in the young Quantz overpowered all other considerations, and, preferring the fiddle-stick to the anvil or shears, he bound himself apprentice to his uncle, the musician, for five years; but this uncle dying three months after, he was transferred to his son-in-law, Fleischhaeck, who was of the same profession; and it was under him that he first practised the violin, an instrument to which his inclination at this time impelled him, preferably to any other.

Soon after this, however, he practised the hautbois, and the trumpet, with which instruments, and the violin, he chiefly filled up the term of his apprenticeship; but as a true town musician, in Germany, is expected to play upon all kinds of instruments, he had been obliged, occasionally, to apply himself, during this period, to the sackbut, cornet, base-viol, French horn, common flute, balloon, viol da gamba, and the lord knows how many more. These were in the way of business, but for pleasure, he now and then took lessons on the harpsichord, of the organist Kiefewetter, who was likewise his relation; by which he laid the first foundation of his knowledge in harmony, and love for composition.

Luckily for Quantz, his master, Fleischhaeck, was not, like other country musicians, fond only of old, dry, stiff, and tasteless compositions, but had sufficient discernment to choose his pieces out of the newest and best productions of the times, by Telemann, Melchior, Hofmann, and Heinechen, which were published at Leipzig; from the perusal, and practice of which, our young performer derived great advantage.

The duke of Merseburg's band not being very numerous, the town-waits, at this time, were often called in, to assist at the musical performances, both of court and chapel. Here Quantz frequently heard foreigners play and sing, in a manner far superior to any professors whom he had hitherto met with, which excited in him a strong desire to travel. Dresden and Berlin were at this time the most renowned cities in Germany, for the cultivation of music, and the number of able musicians. He eagerly wished to visit one of those cities, but was destitute of the means. However, he now began to feel his strength, and trusting to his feet and his fiddle, he boldly set off for Dresden.

It was in the year 1714 that he arrived in that city. His first entrance was not auspicious, being wholly unable to procure employment: on this account, he made an excursion to Radeburg, where a journeyman fiddler being wanting, he entered into the service of the town musician, Knoll; but alas! he was soon driven from this post, by the fatal accident of the town being burnt down by lightning. Again reduced to the state of a fugitive, and a wanderer, he levied contributions round the country by the power of his violin, which was now his principal instrument, till he reached Pirna.

Here, destined still to be *servus servorum*, he could procure no other means of exercising his profession, than by accepting the office of deputy to a sick journeyman musician of the town. It was during this time, that he first saw Vivaldi's concertos for the violin, which were so congenial to his own feelings and ideas of perfection, that he made them his model as long as he continued to practise that instrument.

Still regarding Dresden as his centre, he eagerly accepted an offer that was made to him, of being temporary assistant there, to one of the town-waits, who was then ill; an employment which he preferred, for the opportunities it afforded him of hearing good music and good musicians, to the more honourable post of being the best of bad musicians at Berenburg, where he might have been appointed first violin, with a good salary.

His second arrival at Dresden was in the year 1716, where he soon discovered that it was not sufficient for a musician to be able to execute the mere notes which a composer had set on paper; and it was now that he first began to be sensible of the existence of taste and expression.

Augustus II. was at this time king of Poland, and elector of Saxony, and the orchestra of this prince at Dresden was in a flourishing condition; however, the style which had been introduced there, by the concert-master Volumier, was French; but Pisendel, who succeeded him, introduced a mixed taste, partly French, and partly Italian, which he afterwards brought to such perfection, that Quantz declares, he never heard a better band in all his future travels.

No orchestra in Europe could now boast of so many able professors, as that of the elector of Saxony, among whom, were Pisendel and Vercini, on the violin; Pantaleone Hebenstreit, on the pantaleone; Weiss, on the lute; Richter, on the hautbois; and Buffardin, on the German flute; not to mention several excellent performers on the violoncello, balloon, French horn, and double-bass.

Upon hearing these great performers, Quantz was filled with such wonder, and possessed of such a rage for improvement, that he laboured incessantly to render himself worthy of a place among such honourable associates.

For, nowever prejudiced he may have been in favour of his own reputable calling of *kunstpfeifer*, he began now just to think it possible for him to be prevailed upon, to relinquish that part of it, at least, which required him to play

country dances, though in itself so jovial, pleasant, and festal an employment.

He continued, however, to be the *kunstpfeifer's* delegate in this city, till the death of Augustus II.'s mother, in 1717, at which time, the general mourning proscribing the use of every species of convivial music, he again, in his usual manner, commenced traveller, and fiddled his way through Silesia, Moravia, and Austria, to Vienna; and in the month of October, of the same year, returned through Prague to Dresden; which journey, he thinks, contributed more to his knowledge, in practical geography, than in any other art.

The jubilee of the reformation, brought about by Dr. Luther, happening to be celebrated soon after his return, he was called upon, among others, to perform a part upon the trumpet, at church, where the chapel-master Schmidt having heard him, offered to prevail on the king to have him regularly taught that instrument, in order to qualify him for the place of court trumpeter; but Quantz, however ardently he might have wished for an office at court, declined the acceptance of this, well knowing that the good taste to which he aspired, was not to be learned upon that instrument, at least as it was then played in Dresden.

In 1718, the Polish or royal chapel was instituted; it was to consist of twelve performers, eleven were already chosen, and a hautbois player, only, was now wanting, to complete the number. After undergoing the several trials, and giving the requisite proofs of his abilities, he had the happiness to be invested with that employment, by the director, baron Seyffertitz, with a salary of 150 dollars, and a lodging.

This was an important period in his life, and in the exercise of his profession. The violin, which had hitherto been his principal instrument, was now laid aside for the hautbois, upon which, however, he was prevented from distinguishing himself, by the seniority of his brethren. Mortified at this circumstance, he applied himself seriously to the German flute, upon which he had formerly made some progress without a master; but his motive now for resuming it, was the certainty of his having no rival, in the king's band, as M. Frieße, the first flute, had no great passion for music, and readily relinquished to him his place.

In order to work upon sure ground, Quantz took lessons at this time of the famous Bussardin, with whom, however, he only played quick movements; in which this celebrated flute-player chiefly excelled. The scarcity of pieces, composed expressly for the German flute, was such, at this period, that the performers upon that instrument were obliged to adopt those of the hautbois, or violin, and by altering or transposing, accommodate them to their purpose, as well as they could.

This stimulated Quantz to compose for himself; he had not as yet ever received any regular instructions in counterpoint, so that, after he had committed his thoughts to paper, he was obliged to have recourse to others to correct them. Schmidt, the chapel-master, had promised to teach him composition, but delayed keeping his word from time to time, and Quantz was afraid of applying to Heinichen, his colleague, for fear of offending Schmidt, as these masters were upon bad terms together. In the mean time, for want of other assistance, he diligently studied the scores of great masters, and without stealing from them, endeavoured to imitate their manner of putting parts together, in trios, and concertos.

About this time he had the good fortune to commence a friendship with Pifendel, now appointed concert-master, in the room of Volumier. Quantz is very warm in his praises of Pifendel, whom he calls a profound theorist, a great per-

former, and a truly honest man. It was from this worthy concert-master that he learned to perform an adagio, and to compose in many parts. Pifendel had in his youth been taught to sing by the famous Pistocchi, and had received instructions, on the violin, from Torelli; however, having travelled through France and Italy, where he had acquired the peculiarities in the taste of both countries, he so blended them together as to form a third genus, or mixed style of writing and playing, which was half French and half Italian. Influenced by his example, Quantz declares, that he always preferred this compound style, to that of Italy, France, or the national style of his own country.

At the marriage of the prince royal of Poland, in 1719, several Italian operas were performed at Dresden. Lotti, the famous Venetian maestro di capella, together with the most celebrated fingers of Italy, male and female, were called thither upon this occasion; these were the first Italian operas which Quantz had heard, and he confesses, that the performance of them gave him a very favourable idea of the genuine and sound Italian music, from which he thinks later times have too much deviated.

After describing the talents of the fingers who will have their place in our alphabet, he informs us that this famous opera at Dresden, was broken up by a quarrel between Heinichen, the king of Poland's chapel-master, and Senesino, who this same year, 1719, went to England for the first time.

Nothing very interesting occurs in the life of Quantz from this period, till 1723, when he took a journey with Weifs, the famous lutenist, and Graun, the composer, to Prague.

Quantz, not long after the coronation of Charles VI. at Prague, went to Italy in the suite of count Lagnaseo, with the consent of his royal master, the king of Poland. He left Dresden in May 1724, and, when he arrived at Rome, he found that Vivoldi had just introduced the Lombard style in that city, with which the citizens were so captivated, that they would hear no other.

During his residence at Rome, he took lessons in composition of the famous Gasparini, who was at that time seventy-two years of age; and after studying counterpoint with him, which he calls music for the eye, he went to work for the ear, and composed solos, duets, trios, and concertos; however, he confesses, that counterpoint had its use in writing pieces of many parts; though he was obliged to unlearn many things, in practice, which theory had taught him, in order to avoid that dry, and stiff style, which too close an adherence to rules is apt to produce; upon this occasion, he very judiciously observes, that invention is the first requisite in a composer, and that it behoves him to preserve a friendship between harmony and melody.

In 1725 he went to Naples, where he met with his countryman Haffé, who then studied under Alef. Scarlatti. Haffé had not, as yet, distinguished himself by any compositions for the stage; however, it was at this time, that a considerable Neapolitan banker employed him to set a ferenata for two voices, which he did in the presence of Quantz; the fingers who performed in it, were Farinelli and Teli. Haffé gained so much reputation by this production, that it paved the way to his future success, and he was soon after appointed composer of the great opera at the theatre royal.

Quantz intreated Haffé to introduce him to his master, Scarlatti, to which he readily consented; but upon mentioning him to the old composer, he said, "my son, you know I hate wind instruments, they are never in tune." However, Haffé did not cease importuning him, till he had obtained the permission he required.

In the visit which he made to Scarlatti, M. Quantz says, that he had an opportunity of hearing him play on the harpsichord, which he did in a very learned manner; but observes, that his abilities on that instrument were not equal to those of his son.

Before his departure from Naples, M. Quantz frequently heard concerts at the duke of Lichtenstein's, in which Hasse, Farinelli, Tesi, and Franciscello, were employed.

In 1726 he was at Venice, during the performance of two rival operas, "Siface," composed by Porpora, and "Siroe," by Vinci; the latter was most applauded. The Cav. Nicolini, a contralto, La Romanina, a deep soprano, and the famous tenor, Paita, were the principal fingers in these dramas.

San Martini, the celebrated performer on the hautbois, who afterwards established himself in London, was now at Venice, as was Vivaldi.

At Turin he met with Sonis, under whom, Le Claire was at that time a scholar on the violin.

From Turin he went to Paris, which, with respect to music, was going from one extreme to another.

His character of French fingering in the former part of the last century, is very just and characteristic.

"I was displeased with the French taste now," says M. Quantz, "though I had heard it formerly with patience. The old, worn-out, second-hand thoughts, and passages ill-expressed, disgusted me now, as much as a stale dish warmed again. The resemblance between recitative and air, with the affected and unnatural howling of the fingers, particularly the women, shocked my ears."

M. Quantz was the first who applied an additional key to the German flute, in order to correct its imperfections; and it was in the course of this year, 1726, that he made the discovery.

In 1727 he arrived in London, where he found the opera in a very flourishing state, under the direction of Handel. The drama of "Admetus" was now in run, of which, he says, the music was grand and pompous. Senesino performed the first male part, and Cuzzoni and Faustina were the principal women.

He then gives a character of the fingers, state of the opera, and of music in general in London, very correctly.

Upon his return to Dresden, he was established in the king's chapel, with an addition to his former salary of 250 dollars a-year. He now entirely quitted the hautbois, supposing it hurtful to the embouchure of the flute, which, from this time, he made his sole study.

In 1728 he went to Berlin, with baron Seyfertz, in the suite of the king of Poland; where he was obliged, at the command of the queen of Prussia, but with the permission of his royal master, to remain for some months. Pifendel, Weiss, and Buffardin, were, by the same order, called thither. After he had had the honour of playing before the queen two or three times, he was offered a place and pension of 800 dollars a-year. He was very willing to accept of them, but the king his master would not grant his consent: however, this prince gave him a general permission to go to Berlin as often as he was desired.

This year, 1728, the prince royal of Prussia determined to learn the German flute, and M. Quantz had the honour to teach him. On this account, he was obliged to go twice a year to Berlin, Ruppin, or Reinsberg, the several residences of his royal scholar.

After the death of the king of Poland, in 1733, his son, Augustus III. not choosing to dismiss M. Quantz, raised his appointment to 800 dollars, and confirmed the permission

which had been granted by his royal father, for his going occasionally to Berlin.

In 1734 he published his first solos; but he does not acknowledge the sonatas, which were printed under his name, in Holland, about that time.

In 1739, M. Quantz finding a great scarcity of German flutes, undertook to bore them himself for the use of his pupils; an enterprise which, afterwards, he found to be very lucrative.

In 1741 he was again invited to Berlin, in order to enter into the service of his royal scholar, then king of Prussia, with offers of an annual pension of 2000 dollars for life; a separate payment for compositions; 100 ducats for every flute he should deliver; and an exemption from playing in the orchestra, or any where else, but in the king's chamber, as well as from dependance on any other commands than those of his majesty; which terms, as the king of Poland was too gracious longer to refuse his dismissal, M. Quantz was unable to resist.

In 1752 he published his "Art of Playing the German Flute;" and it was this year that he invented the new joint for the upper-piece of the flute, by which means, without drawing out the middle piece, and without hurting the tone, the instrument may be raised or lowered half a note.

And now, having traced our industrious musician through the troublesome mazes by which he arrived at the temple of fortune, we had hopes that we should have left him to the enjoyment of that reputable ease, that *otium cum dignitate*, to which every artist in years aspires; but alas! this eminent musician and worthy man died at Potsdam in less than a year after we had seen, heard, and conversed with him in that summer residence of his royal disciple and patron! A complete list of his works is given in Gerber.

QUANUSE, in *Geography*, a town of America, in the Tennessee government. N. lat. $35^{\circ} 12'$. W. long. $84^{\circ} 28'$.

QUAPA, a town of Louisiana, at the conflux of the Arkansas with the Mississippi. N. lat. $33^{\circ} 48'$. W. long. $91^{\circ} 23'$.

QUAPACTOTOTL, in *Ornithology*, a name under which Nieremberg has described a bird, which, he says, imitates the human laugh. He says its body is eight inches long, and the tail as many; the beak of a blueish-black, and bent and crooked; the breast grey, and the belly black; the tail of a brownish-black; and the wings, neck, and head, of a yellowish-brown.

This is the *Cuculus ridibundus* of Gmelin, the *Cuculus Mexicanus* of Brillon, and the Laughing cuckow of Latham. It is found in New Spain.

QUAPIZOTL, in *Zoology*, the name given by Hernandez to the Tajaça of Maregrave, the Pecari of Buffon, and the Mexican hog of Pennant. See *Sus Tajaçu*.

QUAPOYA, in *Botany*, Aubl. Guian. v. 2. 897. t. 343, 344, a barbarous Caribbean name. See XANTHE.

QUAR, in *Agriculture*, a term occasionally employed, in a provincial manner, to signify a small sort of quarry of any kind, but more especially of the lime-stone, free-stone, flag-stone, or slate-stone nature. It is much used in some of the more northern districts of the country. See QUARRY.

QUARANTAIN, in old *Law Books*, written *Quarentine*, and *Quarentena*, denotes the space of forty days.

"Quatuor carucas terræ arabilis, continentes in longitudine 8 quarentenas, & 8 quarentenas in latitudine." Chart. Withlasi Reg. Merc. apud Ingulf.

"Quarentena in London. ponetur pro respectu habend. 40 dies post summationem per breve regis, ut consulat, &c. si sibi viderint expedire." MS. de Temp. Ed. III.

The

The term is borrowed from the French *quarentain*; and is sometimes used for the time of Lent.

QUARANTAIN of the King, in France, denotes a truce of forty days appointed by St. Louis, during which time it was expressly forbidden to take any revenge of the relations or friends of people who had fought, wounded, or affronted each other in words.

QUARANTAIN, or *Quarentine*, is more particularly used for the term of forty days, which vessels, coming from places suspected of contagion, are obliged to wait in certain places appointed to air themselves before they come into port.

By the stat. 26 Geo. II. cap. 6. explained and amended by 29 Geo. II. cap. 8. the method of performing quarantine, or forty days probation, by ships coming from foreign countries, is put in a much more regular and effectual order than formerly; and masters of ships coming from infected places, and disobeying the directions there given, or having the plague on board, and concealing it, are guilty of felony without benefit of clergy. The same penalty also attends persons escaping from the lazarettos, and officers and watchmen neglecting their duty, and persons conveying goods or letters from ships performing quarantine. See *PLAGUE*.

In cases of insurance, before the risk on a ship can be said to be completely ended, she must not only have been 24 hours moored at anchor in her port of destination, but she must have been during that time in *good safety*, in the fullest sense of those words. If, therefore, the ship be obliged to perform quarantine, this does not end the voyage. The voyage only ends when the ship is arrived at her port of destination, and is there moored 24 hours in good safety. Accordingly, if the ship, before the 24 hours are expired, be ordered to the proper place for performing quarantine, the risk continues, though she do not leave her moorings till long after the 24 hours are expired. See *RISK*.

QUARANTAIN also denotes certain duties imposed upon ships, for the purposes of quarantine.

QUARANTAIN, *Quarentine*, or *Quarentena*, in *Law*, denotes a benefit allowed by the laws of England to the widow of a man dying seized of land; by which she may challenge to continue in his capital messuage, or chief mansion-house (so it be not a castle), for the space of 40 days after his decease; during which time her dower shall be assigned. The particular lands to be held in dower must be assigned by the heir of the husband, or his guardian. *Co. Lit.* 34, 35.

If the heir, or any other person, attempt to eject her, she may have the writ *de quarantena habenda*; which lies for a widow to enjoy her quarantain.

QUARANTAIN is also used for a measure or extent of land, containing 40 perches.

QUARANTARIA, in *Geography*, a high mountain between Jerusalem and Jericho; which, as tradition says, is the mountain to which our blessed Saviour was taken by the devil, when he tempted him with the visionary scene of all the kingdoms and glories of the world. This is, as St. Matthew styles it, an exceeding high mountain, and not only difficult, but dangerous, of ascent. It has a small chapel at the top, and another about half-way of its ascent, founded upon a prominent part of the rock. Near this latter are several caves and holes in the side of the mountain, made use of anciently by hermits, and by some in later times, for places in which they kept their Lent; in imitation of that of our blessed Saviour. In most of these grots Maundrell found certain Arabs quartered with fire-arms, who obstructed his ascent, demanding 200 dollars for leave to go up the mountain. He and his companions, says the

traveller, departed without farther trouble, not a little glad to have so good an excuse for not climbing so dangerous a precipice. Maundrell's Journey, &c. p. 80.

QUARANTIA, in the Venetian *Polity*, a court of judicature composed of forty judges.

The Venetians have an old civil *quarantia*, a new civil *quarantia*, and a criminal *quarantia*.

The criminal *quarantia* takes cognizance of all crimes except those against the state, which belongs to the council of ten. The new civil *quarantia* judges of appeals made from sentences made by judges out of the city. The old civil *quarantia* takes cognizance of appeals from sentences of subaltern judges in that city.

QUARARIBEA, in *Botany*. See *MYRODIA*.

QUARE clausum fregit, in *Law*. See *CLAUSUM fregit*.

QUARE eject infra terminum, a writ which lieth, by the ancient law, where the wrongdoer or ejector is not himself in possession of the lands, but another who claims under him. As where a man leaseeth lands to another for years, and, after, the lessor or reversioner entereth, and maketh a feoffment in fee, or for life, of the same lands to a stranger: now the lessee cannot bring a writ of *ejection firme*, or ejectment, against the feoffee; because he did not eject him, but the reversioner: neither can he have any such action to recover his term against the reversioner, who did oust him; because he is not now in possession. And upon that account this writ was devised, upon the equity of the statute Westm. 2. c. 24. as in a case where no adequate remedy was already provided. And the action is brought against the feoffee for deforcing, or keeping out, the original lessee during the continuance of his term: and herein, as in the ejectment, the plaintiff shall recover so much of the term as remains; and also shall have actual damages for that portion of it, whereof he has been unjustly deprived. But since the introduction of fictitious ousters, whereby the title may be tried against any tenant in possession, (by what means forever he acquired it,) and the subsequent recovery of damages by action of trespass for mesne profits, this action is fallen into disuse. See *EJECTIONE Firme*.

QUARE impedit, a writ which lies for him who has purchased an advowson, against him that disturbs him in the right of it, by presenting a clerk to it when the church is void.

It differs from the assize of darrein presentment, *ultima presentationis*, which lies where a man, or his ancestors, formerly presented; this other lying for him who is the purchaser himself. Where a man may have the assize, he may have this writ; but not contrariwise.

In contested presentations, upon the first delay or refusal of the bishop to admit his clerk, the patron usually brings his writ of *quare impedit* against the bishop, for the temporal injury done to his property, in disturbing him in his presentation. And if the delay arises from the bishop alone, as upon pretence of incapacity, or the like, then he only is named in the writ; but if there be another presentation set up, then the pretended patron and his clerk are also joined in the action; or it may be brought against the patron and clerk, leaving out the bishop; or against the patron only. But it is most advisable to bring it against all three: for if the bishop be left out, and the suit be not determined till the six months are past, the bishop is entitled to present by lapse; for he is not party to the suit: but, if he be named, no lapse can possibly accrue till the right is determined. If the patron be left out, and the writ be brought only against the bishop and the clerk, the suit is of no effect, and the writ shall abate; for the right of the patron is the principal question in the cause. If the clerk be left out, and has received

ceived institution before the action brought, (as is sometimes the case,) the patron by this suit may recover his right of patronage, but not the present turn; for he cannot have judgment to remove the clerk, unless he be made a defendant, and party to the suit, to hear what he can allege against it. For which reason it is the safer way to insert all three in the writ.

The writ of *quare impedit* commands the disturbers, the bishop, the pseudo-patron, and his clerk, to permit the plaintiff to present a proper person (without specifying the particular clerk) to such a vacant church, which pertains to his patronage; and which the defendants, as he alleges, do obstruct; and unless they so do, then that they appear in court to shew the reason why they hinder him.

Immediately on the suing out of the *quare impedit*, if the plaintiff suspects that the bishop will admit the defendant's or any other clerk, pending the suit, he may have a prohibitory writ, called a *ne admittas*; which recites the contention begun in the king's courts, and forbids the bishop to admit any clerk whatsoever till such contention be determined. And if the bishop doth, after the receipt of this writ, admit any person, even though the patron's right may have been found in a *jure patronatus*, then the plaintiff, after he has obtained judgment in the *quare impedit*, may remove the incumbent, if the clerk of a stranger, by writ of *seire facias*: and shall have a special action against the bishop, called a *quare incumbavit*; to recover the presentation, and also satisfaction in damages for the injury done him by incumbering the church with a clerk, pending the suit, and after the *ne admittas* received. But if the bishop has incumbered the church by instituting the clerk, before the *ne admittas* issued, no *quare incumbavit* lies; for the bishop hath no legal notice, till the writ of *ne admittas* is served upon him. The patron is, therefore, left to his *quare impedit* merely; which now lies (since the statute of Westm. 2.) as well upon a recent usurpation within six months past, as upon a disturbance without any usurpation had.

In the proceedings upon a *quare impedit*, the plaintiff must set out his title at length, and prove at least one presentation in himself, his ancestors, or those under whom he claims; for he must recover by the strength of his own right, and not by the weakness of the defendant's: and he must also shew a disturbance before the action brought. Upon this the bishop and the clerk usually disclaim all title: save only, the one as ordinary, to admit and institute; and the other as presentee of the patron, who is left to defend his own right. And, upon failure of the plaintiff in making out his own title, the defendant is put upon the proof of his, in order to obtain judgment for himself, if needful. But if the right be found for the plaintiff, on the trial, three farther points are also to be inquired: 1. If the church be full; and, if full, then of whose presentation: for if it be of the defendant's presentation, then the clerk is removable by writ brought in due time. 2. Of what value the living is: and this in order to assess the damages which are directed to be given by the statute of Westm. 2. 3. In case of plenary upon an usurpation, whether six calendar months have passed between the avoidance and the time of bringing the action: for then it would not be within the statute, which permits an usurpation to be divested by a *quare impedit*, brought *infra tempus semestris*. So that plenary is still a sufficient bar in an action of *quare impedit*, brought above six months after the vacancy happens; as it was universally by the common law, however early the action was commenced.

If it be found that the plaintiff hath the right, and hath

commenced his action in due time, then he shall have judgment to recover the presentation; and, if the church be full by institution of any clerk, to remove him: unless it were filled *pendente lite* by lapse to the ordinary, he not being party to the suit; in which case the plaintiff loses his presentation *pro hac vice*, but shall recover two years' full value of the church from the defendant, the pretended patron, as a satisfaction for the turn lost by his disturbance: or, in case of insolvency, the defendant shall be imprisoned for two years. But if the church remains still void at the end of the suit, then whichever party the presentation is found to belong to, whether plaintiff or defendant, shall have a writ directed to the bishop *ad admittendum clericum*, reciting the judgment of the court, and ordering him to admit and institute the clerk of the prevailing party; and, if upon this order he does not admit him, the patron may sue the bishop in a writ of *quare non admittit*, and recover ample satisfaction in damages.

Besides these possessory actions, there may be also had a writ of *right of advowson*, which resembles other writs of right: the only distinguishing advantage now attending it being, that it is more conclusive than a *quare impedit*; since to an action of *quare impedit* a recovery had in a writ of right may be pleaded in bar.

There is no limitation with regard to the time within which any actions touching advowsons are to be brought; at least none later than the times of Richard I. and Henry III.: for by statute 1 Mar. st. 2. c. 5. the statute of limitations, 32 Hen. VIII. c. 2. is declared not to extend to any writ of right of advowson, *quare impedit*, or assise of *darrein presentation*, or *jus patronatus*.

In a writ of *quare impedit*, which is almost the only real action that remains in common use, and also in the assise of *darrein presentation*, and writ of right, the patron only, and not the clerk, is allowed to sue the disturber. But, by virtue of several acts of parliament, there is one species of presentations, in which a remedy, to be sued in the temporal courts, is put into the hands of the clerks presented, as well as of the owners of the advowson. We mean the presentation to such benefices, as belong to Roman Catholic patrons; which, according to their several counties, are vested in and secured to the two universities of this kingdom. And particularly by the statute of 12 Ann. st. 2. c. 14. § 4. a new method of proceeding is provided; viz. that, besides the writs of *quare impedit*, which the universities as patrons are entitled to bring, they, or their clerks, may be at liberty to file a bill in equity against any person presenting to such livings, and disturbing their right of patronage, or his *cestuy que trust*, or any other person whom they have cause to suspect; in order to compel a discovery of any secret trusts, for the benefit of Papists, in evasion of those laws whereby this right of advowson is vested in those learned bodies: and also (by the statute 11 Geo. II. c. 17.) to compel a discovery whether any grant or conveyance, said to be made of such advowson, were made *bona fide* to a Protestant purchaser, for the benefit of Protestants, and for a full consideration; without which requisites, every such grant and conveyance of any advowson or avoidance is absolutely null and void. Blackst. Com. b. iii.

QUARE incumbavit, a writ which lies against the bishop, who, within six months after the vacancy of a benefice, consents it on the clerk of any one, while two persons are contending at law for the right of presenting. This writ lies always depending the plea. See the preceding article, *PRESENTATION, ASSISE of darrein presentation, &c.*

QUARE

QUARE *non admittit*, a writ which lies against the bishop, for refusing to admit his clerk, who has recovered in a plea of advowson, on pretence of lapse, &c. See **QUARE impedit**.

QUARE non permittit, is a writ that lies for one who has a right to present for a turn against the proprietary.

QUARE obstruxit, a writ that lies for him, who, having right to pass through his neighbour's grounds, cannot enjoy the same, because the owner has fenced it up.

QUARENTINE. See **QUARANTAIN**.

QUARERA, or **QUARATIA**. See **QUARRY**.

QUARITZ, in *Geography*, a town of Silesia, in the principality of Glogau; 8 miles W. of Gros-Glogau.

QUARKEN, or **QUERKEN**, a cluster of small islands, in the gulf of Bothnia, near the east coast. N. lat. $63^{\circ} 16'$. E. long. 21° .

QUARLES, FRANCIS, in *Biography*, an English poet, born in 1592, near Rumford, in Essex, was son of James Quarles, esq. who held an office at the navy board in the reign of queen Elizabeth. The subject of this article was educated at Christ's college in Cambridge, and was afterwards entered a student in Lincoln's Inn. He obtained the place of cup-bearer to the queen of Bohemia, daughter to James I.; and upon his return, he was appointed secretary to archbishop Usher in Ireland, from which country he made his escape, on the breaking out of the rebellion in 1641, after the loss of his property. He had before distinguished himself by some works, chiefly on religious subjects, in consideration of which he had a pension from Charles I. About this time he had the post of chronologer to the city of London. On the commencement of the civil wars, he gave great offence to the parliament by a work, entitled "The Loyal Convert;" and when he actually joined the king at Oxford, he was plundered of his estates, his books, and manuscripts. These losses he did not long survive. He died at the age of 52, in 1644. Of his numerous writings, as well in prose as in verse, the most celebrated, and indeed that by which he is almost entirely known, is his "Emblems," a set of designs exhibited in prints, and elucidated by some lines attached to each. A considerable part of the work is borrowed from the "Emblems" of Hermannus Hugo, but his verses are his own. For a considerable time they excited a large portion of public admiration in the religious world. They then fell into contempt; but we believe a new edition has of late years been given to the world. Quarles is thus characterized by an able critic: "He is by no means without his beauties; and his verses, which are generally smooth, afford occasional bursts of fancy, and strokes of pathos, which shew real genius, though overrun with false taste. Mr. Jackson of Exeter, in his "Letters on various Subjects," endeavoured to recall the public attention to this neglected poet, and pointed out with much feeling some of his brilliant passages; but though curiosity may be amused by hunting for his scattered beauties, he can never regain a place among the English classical poets."

QUARLESVILLE, in *Geography*, a post-town of America, in Brunswick county, Virginia; 204 miles from Washington.

QUARNAMELA, a town of Sweden, in the province of Smaland; 23 miles S. of Wexio.

QUARNERO, or **CORNERO**, *Gulf of*, a part of the Adriatic, between Istria and Morlaclia, anciently called "Sinus Flanaticus." It is subject to sudden storms and hurricanes, which render its navigation dangerous.

QUARRE', Fr. In old French music, B quarré was the term for B $\flat$. See **QUADRO**.

QUARRÉ les Tombes, in *Geography*, a town of France, in the department of the Yonne, and chief place of a canton, in the district of Avallon; 6 miles S. of Avallon. The place contains 2007, and the canton 7287 inhabitants, on a territory of $192\frac{1}{2}$ kilometres, and 9 communes.

QUARRE'E, in the old French time-table, implied a breve, or square note, equal to two semi-breves. See **TIME-TABLE**.

QUARREL, **QUERELA**, in *Law*. See **QUERELA**.

Quarrel seems properly to relate to personal actions, or at most to mixed ones, wherein the plaintiff is called *querens*; and in all declarations of trespass, it is said, *queritur*.

Yet if a man release all quarrels or querels, (a man's own deed being taken most strongly against himself,) quarrel includes all actions; and accordingly all actions, both real and personal, are hereby released.

Quarrels or affrays in a church or church-yard are esteemed very heinous offences, as being indignities to him to whose service those places are consecrated; therefore mere quarrelsome words, which are neither an affray nor an offence in any other place, are penal here. See **AF-FRAY**.

QUARREL between the French and Italian fingers at Rome, in the time of Charlemagne; for which we refer to our article **CHARLEMAGNE**. See also **ROUSSEAU'S Dict.**

QUARREL, in *Armoury*, a bolt, or square-headed arrow, to shoot out of an arbalist, or cross-bow.

QUARREL of Glafs. See **QUARRY**.

The word is formed, by diminution, from the Latin *quadratum*, or the French *quarré*, *square*; or, perhaps, immediately from the Italian *quadrello*, *little square*.

QUARRY, in *Agriculture*, the common name of an opening, pit, drift, or shaft, which is dug into the earth or ground, and from which are to be raised ores of various kinds, different sorts of stones, slates, and other materials of similar natures. It is remarked by the writer of the work on "Landed Property," that the more useful and advantageous materials and substances that have at different times been dug and raised out of quarries in this country, are chiefly those of the iron ore kind, lime-stone, and other calcareous matters, materials for building, such as slates, flags, stones, and substances of other sorts, matters for the constructing and repairing of roads, as sand, gravel, and others of the same nature, earthy substances for the purposes of different manufactures, such as clays, &c. moulds and vegetable earthy matters, and coals, with other articles for use as fuel. There are, however, occasionally raised from openings of this nature, a few other kinds of substances, such as will be noticed below.

It has been farther supposed by the above writer, that the substances which he has here mentioned, may with truth be said to be of more real use and value to mankind than all the mines of precious metals in the world; and that the eyes of the managers of landed estates should constantly be turned towards and fixed upon the discovery of the hidden valuable treasures and productions of this nature, wherever there is a probability or likelihood of their being to be met with. It is also suggested, that it would be highly beneficial and advantageous if mineralogists, and those who are acquainted with such substances, were to turn their attention towards the appearances or accompaniments which point out such useful concealed matters; as it might greatly facilitate the search for them, and frequently lead fortuitously to their discovery. The methods which are practised in searching for and ascertaining the presence of different sorts of materials

rials of this nature, are principally those of boring, by means of an auger or borer made for the purpose, into the earth, and digging into it in other ways. In searching for most sorts of mineral substances, coals, and some other matters, the use of the borer is constantly first had recourse to, and not that of sinking a shaft, however favourable the appearances of the place may be for the purpose, and the success of the undertaking. The ground is first tried by this means, and a certainty of success or failure gained, as well as that of the most proper situation for sinking the shaft or making the opening or pit, without much expence being incurred, in case of the former. In trying for ochres, marles, and other similar articles, the same implement is also in common use. But in raising and providing lime-stone, free-stone, flags, and slates, &c. in some cases, digging down into and opening the ground, by spades and other tools, is the mode employed in the first instance, in consequence of such substances being obviously present in sufficient quantities to be wrought with advantage. See *BORER, BORING, and AUGER*.

The common methods of working and managing different sorts of quarries, are in general, in most places, tolerably well understood and regulated, by such quarrymen as are constantly employed in the business; but a circumstance which they commonly neglect very much, or are in a great degree inattentive to, in many cases, is that of making good the ground below, by means of the turf or soil which is cast off from the top, or upper parts; and that of keeping the mouths of the openings sufficiently clear and free. Another common difficulty incident to them, is that of draining, and freeing their bottom parts from injurious water. This may be effected in various ways, as by the use of different sorts of machinery worked by wind, water, and steam, and by some other means. See *QUARRIES, Pits, &c. Draining of*.

In many of the more southern districts of the kingdom, and still more in those towards the north, and in Wales, there are quarries, from which substances of some of the following kinds are raised and used in their neighbourhoods, or sent away to a distance, in a very extensive manner; such, for instance, as those of the stony kind, as iron-stone or ore, lime-stone, marble, chalk, granite, free-stone, grit-stone, flag-stone, white, grey, purple, and blue slate-stone, sand-stone, sand, gravel, clay-stone, scythe-stones, tile-stones, &c.; different ochres, plumbago or black lead, calamine, gypsum, marle, pipe-clay, alum-earth, fuller's-earth, peat-earth, culm, coal, cannel, salt-rock, &c. These quarries and pits are wrought, and the materials got up from them, in several different ways, according to circumstances and convenience, as well as the particular nature, kinds, qualities, &c. of the different articles themselves; all of which are mostly well known, and capable of being performed by the workmen of their respective neighbourhoods, who are commonly employed in them, and very expert in their management.

Stony substances which bear a great variety of different names, and which possess equal variety in their qualities and useful properties, are met with, and dug up from quarries and pits, in many different districts and situations, in almost all parts of this island, in order to be converted to purposes of improvement and utility in a variety of different ways and intentions. Iron-stones and ores abound more in the northern parts, though they are occasionally found in some of the southern ones. A considerable quantity of highly rich iron-stone is got up and sent annually from the vicinity of Combemartin in Devonshire, to the iron-works of Mr. Raby at Llenethy in South Wales. A large portion of it is also found on the borders of the Orchment river, and dispersed throughout the whole district, as well as in other parts of the same county.

Iron-stone is likewise met with in Suffex in large quantities, imbedded with lime-stone and sand-stone, that which rises near to the surface being the best, the other having a coarser and more dull appearance, working heavier in the furnace. The very best is frequently intermixed with thin stripes of soft marly matter. Iron-stone, to a great extent, exists on the estates of lord Dudley, and many others in Staffordshire, and contributes much to the employment and prosperity of the inhabitants. But, in the northern part of Lancashire, in the district of Low Furness, stone and ore of this sort are perhaps found in the largest quantity, of the best kind, and in the most general manner, of any where in the kingdom. There are numbers of shafts, quarries, and pits for raising them from, on Lindal Moor, Whittig Moor, and Cross Gates, in the vicinity of Dalton, as well as in some other places. In the former, the working is usually effected at the depth of from twenty to forty-five feet, but it has been done at less as well as greater depths. The whole of their cavities are chambered with wood, and cost from a guinea to twenty-five shillings in sinking each fathom, without the wood. The ore runs in veins or seams between the rocks on the north and south, being in breadth from about forty to sixty yards. And it constantly dips towards the south-east at the rate of about a foot in five or six. The best ore is that which has the most greasy appearance, and it is raised with less difficulty, working less hard, requiring less flux, and forming a more soft iron. It is raised from the shafts or pits by machinery of the gin or windlass kind, the men employing picks, punches, and hammers in digging it up. It was formerly got, in some places, by driving levels into the sides of the hills, and conveying it out on railways, in small waggons; but now the other way is mostly employed. Four men get about fourteen tons in the day, in some situations; but in others, double the number are required for getting the same quantity. It is wheeled to distant heaps, from which much of it is sent in small carts to the port of Old Barrow, from whence it is shipped to different parts of England, Wales, and Scotland, at the expence of from fourteen to thirty shillings in freight; and the rest converted into pig-iron by the furnaces in the neighbourhood. Iron-stones and ores are also met with in some other counties more to the north of the kingdom, where there are pits and quarries for raising them from.

Lime-stone is a very general sort of stone raised from quarries and pits in many different parts of this country, as in Devonshire, Suffex, Kent, &c. towards the south, where it lies in vast beds, from which it is dug for use; in the more midland counties, as in Gloucestershire, Shropshire, Derbyshire, Staffordshire, and others, where it exists and is employed to a still greater extent; but by far the most extensively in those farther to the north, as Lancashire, Westmoreland, Yorkshire, Cumberland, and some districts of Scotland. In many parts of the county of Lancaster it is dug and raised from quarries, where it lies in a stratified manner at no great depth from the surface, being got up without much difficulty or trouble; while in other places it is forced from the solid rock, with great labour and expence. This is likewise the case in many other districts. Wherever it is met with, it is almost constantly a quarry material of great value, and which affords much employment to labourers.

In the county of Kent, the banks of some of the large rivers are scooped out into stone quarries in a remarkable manner, some of them worn out and disused, others in the state of being wrought. It has been observed, that this is the nearest stone country into which water-carriage can penetrate from the metropolis; and that the original London

was built, as well as the modern one chiefly paved, by materials from this district, such as the rag-stone, and the large pebbles gathered on the sea-shores, before the Scotch granite came into use. In the neighbourhood of Maidstone there are the appearances of many abandoned and neglected quarries of this nature; but the most considerable ones, which were lately wrought in that vicinity, are those of Farleigh and Fant. In each of these, blocks of stones, of different kinds, and of every form and size, are met with, being separated by seams, and large irregular masses of earth of various qualities: among the rest, brick-earth of the best quality. In some places, the stones are buried several feet under these earthy materials; in others, the rock rises to the surface. After this, the quarrymen worm their way; following it, with irregular windings, leaving behind them refuse in greater quantity than the useful materials which they raise.

The stony substances which are principally met with in them, are of two very distinct kinds: the one hard, and of a strong contexture, provincially denominated *rag*, or Kentish *rag*; the other of a soft crumbly nature, provincially termed *haffock*. The quarrymen are in the practice of dividing the first sort into two kinds; what they call the *common rag*, and the *cork-stone*, the latter being their principal object in these immense works. It has in its general appearance much resemblance to the strong grey lime-stones which are found in different parts of this country; but when minutely examined by means of a glass, its fracture and contexture have the characters of the Devonshire marbles; except that the grain of this sort of stone is somewhat coarser. In colour, too, it differs from these marbles, having a greater resemblance to the Yorkshire lime-stones. It is used for different purposes; much of it is sent to the neighbourhood of London, where it is burnt into lime, for the use of the sugar-bakers; who, for some reason or other, chiefly employ lime, burnt from this material, or stone, instead of that of chalk. It is likewise made use of as a building material; and, particularly in pedestals, for the posts of cattle-sheds and other farm-offices. It is hewn with stone-masons' axes, working with tolerable freedom.

It is very durable, as some part of the basement of Westminster Abbey appears to have been built with the stone from these quarries. In this case, it seems to have been dressed smooth; and the surface still remains with little alteration; having withstood the attacks of time with great firmness; it being even now difficult to detect a loosened splinter in the work.

The common rag-stone comprehends all the different kinds which are met with in these quarries, except that of the above, and that which is of the haffocky nature; though the true unmixed rag is a distinct sort, having characters different from any of the others. In the colour, it inclines more to the red or liver colour, than that of the cork-stone, but otherwise resembles it considerably. Viewed with a glass, its grain is finer, and the fracture flint-like.

Its uses are, however, but few. Some of the best and most regularly-faced stones are sometimes laid aside for paving materials; but the large pieces are mostly reserved, in order to be sent by water to the district of Romney Marsh, for the purpose of forming the hard materials of the embankments and jetties, which are there made against the sea. The smaller sorts are, in general, converted to use as a road material.

The haffocky stone appears to the naked eye to be of a soft, white, sandy quality; and its fracture is the same. But under the glass, its grain is fine, its contexture uniform, and so thickly interspersed with small seed-like granules,

of a dark or black colour, as to give it a grey appearance. Sometimes bearing evident impressions of shells. Its texture is loose and brittle; crumbling easily between the fingers into a coarse sand-like powder. It will not burn into good lime, although it is almost wholly calcareous.

Its principal use is that of forming a loose friable sort of rubbly sub-soil, in some places, which is admirably suited to the growth of faintoin, and some other crops of the plant as well as the fruit-tree kinds.

The quarries in several other counties contain stony materials of these different kinds, which are wrought and applied to a variety of different uses in these and other ways.

Quarries of marble are wrought in several districts in different parts of the country, and afford great advantages in various ways. In Sussex they have a marble, which, when cut into slabs, is used for ornamenting chimney-pieces, and many other purposes. It is equal in quality and beauty to most sorts when highly polished. For square building and paving it is also a material scarcely to be exceeded. By burning, it likewise affords a very valuable manure, equal, and by some thought superior, to chalk, being cheaper to those who are near the places from which it is dug. It is found the most perfect about Kirdford, at the depth of from ten to twenty feet underground, in flakes nine or ten inches in thickness, and called the Petworth marble. It was much employed in building the cathedral at Canterbury, the pillars, monuments, vaults, pavement, &c. being formed of it. And the archbishop's chair is one entire piece of it. Marble is gotten in some of the counties in the middle of the island, as Derbyshire, Nottinghamshire, &c. At Beacon-hill, near Newark, a blue stone for hearths is got, which approaches to marble, and is capable of burning into lime. And in the county of Derby much good marble is raised in different places. In Lancashire there are quarries of fine black marble, and of stones, which approach to, and take on the polish of marbles. In many of the western and northern parts of Yorkshire, marble of various kinds is found, some much resembling, and others superior, in closeness of texture and distinctness of colours, to that which is wrought in Derbyshire. Also a stone, which greatly resembles the marble of that county, and which is capable of receiving much such a polish, and is nearly of the same colour, mixture, and appearance. On the side of the river Kent, near Kendall, a vein of beautiful marble has been lately discovered in the property of D. Wilson, esq. of Dallam-Tower; and a main quarry opened upon it. Marble has also been met with on the opposite bank.

In the county of Inverness, likewise, marble of the greatest variety of colours, and of the most beautiful shades, has been met with in Benevis, on the property of Mr. Camerton; and inexhaustible quarries of it lie untouched in the islands which belong to it.

Besides, this sort of material exists in immense quantities, in quarries, in many other parts of the kingdom.

Chalk is a material which is raised from quarries and pits, mostly in the southern parts of the country, as in Sussex, Surrey, Kent, Essex, Berkshire, Hertfordshire, &c. It exists in vast ranges and tracts in most of these districts, whence it is dug up from quarries, at different depths, according to circumstances, exposed in sheds to dry, when wet, and then converted into lime for various uses, by means of fire, or employed in its broken and powdery state, without undergoing the above processes, by merely digging it out of such places. In some parts, as in Kent, and the neighbouring districts, it is often dug and raised from considerable depths, from beds of very great thicknesses. And near Reading, in Berkshire, there is a stratum of this substance,

stance, which is thirty feet in thickness. It is there used and dug out for manure, and occasionally as a building material, for the latter of which purposes it is very durable. The remains of the abbey of Hurley, and of the ancient chapel, now the parish church, built wholly of chalk, in the reign of William the Conqueror, are, it is remarked by the writer of the corrected Agricultural Survey of the district, still as fresh and sound as if they had been the works of the last century. Chalk, when once indurated by the air, has a remarkable property in resisting the action of the weather.

Granite is a stony substance, which is found to exist in some of the southern parts of the country, as well as in those of the north, but it abounds much more in the latter.

In the western parts of Cornwall it is in great plenty in the districts of Penwith and Kirrier, presenting itself in large slabs on all the rocky hills or tors, as well as in the waste moors and valleys; and appearing in detached spots, even in the shelly flaty tracts. It is of different colours and textures, being adapted to a great variety of uses and purposes, as those of building, and being wrought into columnar masses, eight or ten feet in length, for supporters to sheds, out-houses, &c.; and as gate-posts, and bridges over brooks, rivulets, &c.; as well as in the forming of rollers, malting, salting, and pig troughs. It is also an article of commerce to different parts. It is supposed to be exactly of the same nature with the original granite; and there are five sorts of it, which are distinguished by their colours, the white, the dusky, or dove-coloured, the yellow, the red, and the black, most of which are charged with a brown and bright silvery matter.

The county of Inverness has a great deal of this sort of stone, and there are numerous quarries in it for raising and working of it. The common granite abounds in all the different districts of it. In many places the whole rocks are composed of this kind, which is uncommonly useful for all ordinary purposes. By natural fissures, which run in straight lines, and generally at right angles, it is formed into all sized portions and shapes, having uniformly a plain surface. And, by means of cutters or transverse lines, these stones are easily quarried, and found in the greatest plenty every where. They are remarkably beautiful, being almost as smooth and regular as hewn stone, and of course well suited for various sorts of building work. The best buildings of the county-town are of a dark kind of granite, which is very hard and durable, but which has few or no fissures. It is generally found in large blocks, and in many of these parts, there is no other material for building or adding ornament with. The manner of giving it the polish it admits of at the quarries, is by means of small picks, or pick-axes, which are, in fact, hammers with sharp points at each end, in the manner of those employed by millers in preparing their grinding stones. It is a very heavy, compact stone. There is a mixed sort, denominated peasy granite, which consists of white, black, and grey spots, that sparkle beautifully in the sun, and is very ornamental, as well as much used for different purposes, as stairs, doors, and windows. Though this is very solid, and almost without natural fissures, it splits very straight, by means of iron wedges, set in a line, and struck alternately, with a hammer of great power.

A great deal of this kind of stone is imported into the metropolis and other large towns, for paving the streets, &c. It is on the whole a very advantageous sort of quarry material in various parts of the kingdom.

Quarries of free-stone are wrought in a great number of different places. In the more southern parts is found the

Portland stone, which is so famous and useful in building. A sort of this kind of stone, which much approaches to it in quality, is also met with in Cornwall. Some likewise exists in Devonshire and Gloucestershire. The Cotswold quarries in the latter, afford free-stone of an excellent quality, particularly those at Painswick, Lodbury, Lockhampton-hill, &c. It abounds more, however, in Cheshire, Lancashire, Westmoreland, Cumberland, and some of the still more northern districts. Several excellent quarries of free-stone are carried on in the first of these, as those at Runcorn, Manley, &c. where much valuable stone of this nature is raised. The second county also affords equally valuable quarries in many different places, from which vast quantities of the stone are raised, and employed, or sent away to a distance. Those about Ormskirk, Up-Holland, and Wigan, as well as those on all the eastern side, are in general of a very good quality. And in the vicinity of Lancaster there are some excellent ones; that on the moor or common, close to the town, is very extensive, and affords a free-stone that admits of a fine polish. In this district, this sort of stone is met with of a whitish-brown, yellowish, and reddish cast, but the first is by much the most esteemed. In the eastern parts of Westmoreland, as about Hutton Roofe, and some other places, a good sort of free-stone is dug up from pits and quarries formed for raising it. This sort of stone exists and is quarried almost all over the counties of Cumberland and Northumberland; and prevails occasionally in others, where it is wrought to advantage. A grit-stone, somewhat of this nature, is met with in some districts, as in Shropshire, &c. which is raised from quarries, and used as a building material. And a sand-stone exists to considerable extent in others, as in Suffex, &c. that is sometimes dug up, and made use of for common buildings, &c. In Cheshire, on the hills near Macclesfield, about Kerridge, a sort of sand-stone is met with, which is particularly well suited to the making of flags, and whetting tools, as well as sometimes to the forming of slates, for which it was formerly much employed. Near Pott-Shrigley, also, a fine sand-stone is found, that admits of a good polish. The quarry has not, however, been wrought for some late years, as from the extreme hardness of the stone, the expence of getting it is very considerable. There are several other quarries of excellent free-stone wrought in the same neighbourhood.

There has been great abundance of free-stone wrought, time immemorial, in the low parts of the county of Perth, and quarries of a greater or smaller grained stone of this sort appear almost in every place, with the exception of the carses. In the lowlands, and near to the eastern sea, the pores and grain of it are greater; but as the mountains are approached, the pores are less, and the grain finer, by which these stones admit a smoother polish. The quarry of Tullyalan parish, called Long-annat, affords a stone of a very excellent quality. It has a white colour, admits of a smooth polish, and resists the influence of the weather. Some of the principal houses in that part of the country, as well as some of the most magnificent public buildings in the capital of Edinburgh, as those of the Exchange, the Infirmary, and the Register-office, consist partly of this stone, and those found at hand. And farther, in some instances it has been carried to the continent. But the quarry of Kingoodie, in the carse of Gowrie, belonging to Mr. Mylne, of Mylnfield, is unquestionably the finest of this kind of any in the county. Astonishing blocks in great number are raised there, fifty feet in length, sixteen feet in breadth, and three feet in thickness. Such is the demand for this stone, both at home and abroad, that four vessels are employed in exporting it from this quarry. The work is, however, on the de-

cline, occasioned by the act of 1794, which imposed a duty on stones, which, although trifling in itself, causes much grievance, vexation, delay, and trouble, in procuring coast-dispatches, &c.

Flag-stones and quarries for the working and preparing of all sorts of flags, are met with in all those situations where free-stone is found, and where it exists in rather thick strata, or layers of some depth, which are capable of being separated by hammers, wedges, or other means. In many places in the southern parts of the island, the flags raised from such free-stone quarries are of an extremely good quality, being used in very large quantities for many different purposes. Those of Cornwall and Devonshire also, in many cases, afford a good sort of flags. The sand-stone quarries of Shropshire, as at Grinell, near Shrewsbury, about Bridgnorth, and at Corndon-hill, near Bishop's-castle, as well as in the Swinney mountain, &c. where alternate beds of fine white and red stone of this kind, of very superior quality and thickness, exist; that in the first of these situations, being twenty yards thick, affords flags likewise, which are of a very useful nature. Free-stone flags too, of useful sorts, are met with in the quarries of some of the midland counties. And they abound much in many of the free-stone quarries of Lancashire, Yorkshire, and some of the other more northern districts of the country.

The quarries of this kind become slate-stone, and furnish the white, grey, and brown slate, wherever the stone lies in thin layers, or strata, which are able to be raised and separated from each other with convenience and facility. They exist in most of the above tracts, and are plentiful in some of them, especially those towards the north. The Lancashire and Yorkshire quarries, in many places, supply the white and grey sorts in great abundance, and of good qualities. Those of Westmoreland, Cumberland, and Northumberland, also afford them in many instances of a valuable nature. And they are equally good in the still more northern districts. There are numerous quarries of different colours of them in Clydesdale, Perthshire, Argyleshire, and the county of Inverness, from which vast supplies are constantly raised for home and other use. This sort of slate has, however, mostly the disadvantages of being very porous, heavy, less durable, and of requiring more and stronger timber to support it, than some other kinds; being only fit for exposed climates and situations.

The quarries of the lighter and thinner kinds of slate, of the blue, green, purple, and other colours, formed from other sorts of stone, only exist in some particular districts, as those of Wales, the northern part of Lancashire, and the adjoining counties, and in a few places in Scotland. The slate quarries of the Welsh districts supply several kinds and colours in large quantities, and of good qualities, but the dark and lighter purples are the most prevalent sorts in most of them. In Lancashire the quarries of this kind are very numerous in the part to the north of the fens, as about Gothwaite-common, Kirby-moor, Conistone-hills, and Tilberthwaite-fells, &c.; and from which very large supplies of the blue, green, and the dark purple sorts of slate are raised, and sent away for exportation, or consumed at home for different purposes. They are wrought, and the slate prepared in somewhat different manners in different places. The Gothwaite quarries have the slate dug out from the side of the hill, and carried away. But in some on Kirby-moor, a level is driven through the ground from below, the metal being conveyed away by small four-wheeled waggons on iron rail-ways. Those about Conistone are mostly worked into the hills, and the metal raised and carried out from them. Some of the Tilberthwaite quarries are wrought

by blasting the slate-stone, and collecting and carrying it out of them on slanting roads, in small carts or trucks constructed for the purpose, the level being below the hills, but not nearly so low as the bottoms of the quarries. Others are wrought by draught roads from the bottoms of them. One man will raise eighteen or twenty hundred weight of slate in one day, where the metal rises well, but less in other cases. In some it is dug out by one set of men, split by another, and formed into slates by a third, for which purposes, flat crow-bars, slate-knives, and axes are employed. The slate is divided and distinguished into three sorts, as firsts, seconds, and thirds, or London, country, and toms. In the first, or Gothwaite quarries, the slate has a darkish purple, or black cast, and is worth from forty to forty-four shillings the ton. In the Conistone quarries it has a fine blue and green appearance, and is much thinner and lighter than the other sort. The Tilberthwaite slate, in some instances, splits very fine, thin, and light, but does not cover so far as those of the Gothwaite and Kirby quarries. This sort is worth from forty-eight to fifty shillings the ton. In some quarries a sort of rent is paid *per* ton, on the slate which is raised, as ten shillings for the best, eight shillings for the seconds, and sixpence for the thirds. In others a certain rent only is paid for the liberty of the royalty, and not a tonnage duty. These rents or duties on the workers of these quarries, are probably higher than they will bear, and have enabled the Welsh slate dealers to undersell those of this country.

Westmoreland and Cumberland, in some instances, afford good blue and green slates. In the latter, some of an excellent quality are gotten in the quarries of Borrowdale, and inferior sorts in some of the neighbouring mountains.

The county of Argyle, in Scotland, in some parts abounds with slate-quarries, as the tracts about Eisdale, from which five millions of slates have for some time been annually sold at the rate of twenty-five shillings the thousand. Quarries of the same kind are also wrought in many other parts, with great benefit to the inhabitants.

Slate-quarries are formed in many parts of the highlands of the county of Perth, but none in the low. The slates in some are of a purple colour, in others of an azure blue, and in a few of a muddy, sandy, brown complexion along the cutters. It is well known where the different sorts are quarried. The veins of slate-rock seem to run from Drumlane, in the parish of Aberfoil, in a north-east direction to Dunkeld; and may be traced beyond the limits of the county both ways. The azure coloured are the best metal, and rise of a greater size than any of the other kinds. Many of the buildings in different places are slated with this beautiful covering. Into the lower districts of the county, slates are imported from Eisdale, and the other quarries on the west coast of the county of Argyle.

Quarries of grey slate exist in many different parts of the county of Inverness, in which the quality is very good, and well suited to the climate. In some places these slates are much preferred to blue ones, as the latter are more expensive in procuring, and though nailed on the roofs ever so firmly, are apt to be loosened by high winds, unless bedded in lime, which circumstance renders repairs difficult.

There are numerous quarries of sand and gravel to be met with in almost every district of the kingdom, which are wrought either for the purpose of supplying domestic uses, or those of repairing roads, &c. Those of the former sort, which contain the fine white, red, and yellow sands, are by far the most valuable, and wrought to the greatest extent, the materials being mostly dug out from the sides of banks and other places, and but rarely got by sinking the

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the quarries into the more level parts of the ground, though this method is sometimes practised. The matters are commonly raised simply by digging and spades; and thrown into the carts, in many cases, from the quarries and pits themselves. Numerous quarries and pits of this nature exist and are wrought to a very great extent in the neighbourhoods of the metropolis, and most other large towns, all over the kingdom, for the purpose of sale for various domestic uses.

In the gravelly kinds, those quarries which abound with the sharp, coarse, flinty, and pebbly sorts, are the most proper and beneficial for the making and repairing of all sorts of roads and carriage-ways. They are occasionally formed by working into banks and steep places, but more frequently by openings in the plain surface. Their depth is sometimes considerable, the materials being raised after being screened, the work, of course, very laborious and troublesome. In other cases, the carts are filled from the quarries or pits without much difficulty or trouble.

Quarries of clay-stone, stone-tiles, scythe-stones, and some other sorts, are found of good qualities in different districts. In Gloucestershire they have quarries of blue clay-stone at different depths, lying in beds of the same coloured clay, disposed in layers of from four to ten inches in thickness. The stone in new quarries is estimated by the effects which the atmosphere has upon it from some exposure. The best sort is a very useful material for several purposes. Quarries of stone-tiles principally exist, and those articles are raised from them, in different part of the Cotswolds. The best are prepared about Miserdine, Beverstone, Charlton, and Hampton-field, the colour of which are yellow or grey; but another sort, which is red grit, is dug up about Iron Acton, and some other places, but which is less valuable.

There are quarries of scythe-stones in many parts of Lancashire, but the best are obtained from those about Rainford, where they are well wrought and prepared for use. In several other districts, quarries of different kinds of whetting-stones likewise exist, and are wrought to advantage.

Ochres of different kinds are met with in different places in quarries formed for the purpose of raising them. In the county of Devon, formerly large quantities of various shades between red and yellow, were raised and manufactured in those about East-down. Umber, in the parish of Combemartin, exists in a pretty large body. The working and preparing of these are, however, now much less attended to than heretofore.

In Suffex there are quarries of red ochre about Graffham, and in various places contiguous to the sea, as near Chidham, &c. where much is raised, prepared, and sent to London. Ochre quarries also exist in many counties more to the middle and north of the kingdom, from which great quantities of this substance are procured and prepared for use in different sorts of arts and manufactures.

Quarries of plumbago, or black lead, are likewise occasionally found and wrought, in different situations, in different districts of the country. This substance has been met with and raised near the borders of the Bovey river, in Devonshire, in some quantity, and prepared to be sent to Exeter for sale. Quarries of black lead are also found and wrought in Borrowdale, in Cumberland, near to the town of Keswick, to some advantage. And they exist in some of the middle tracts of the island, affording great benefit to the proprietors of them. In the county of Inverness, there are some appearances of black or pencil lead about Glengary, but they have not yet been turned to any useful account.

In some districts, in the middle parts of the country, quarries of calamine, or *lapis calaminaris*, are met with, and much of this substance raised from them to great profit. It abounds in the Mendip-hills, in Somersetshire, about Rowbarrow, Shipham, Winscomb, and on Broadfield-down, &c. It is sometimes found within a yard of the surface, and seldom wrought deeper than thirty fathoms. In some places its quality is excellent. It is present in other neighbouring mountainous tracts, and raised with equal advantage.

Quarries of gypsum present themselves in many different parts, and are wrought in some with considerable benefit. In the county of Devon, it lies between Strata of red stone, marle, and chalk rubble, about Salcombe, Branscombe, and Beer, being useful for various purposes. Gloucestershire and Derbyshire have quarries of this nature, where there are fine beds of it. Those of Aust Cliff in the former, have it not so good, however, as that which is met with in the latter county. In Nottinghamshire it is of an excellent quality, especially that got near Newark and at Redhill. Cheshire has some, but not turned to much account. Westmoreland and Cumberland have good quarries of it, in some places, where a great deal is gotten up, and made use of. And it abounds in different parts of the county of York, where it is raised to advantage.

Marle is an article that is met with in pits and quarries in a variety of different situations, and of several different kinds and qualities. It is found and dug up for use in many places in Suffex, and the counties more to the centre of the country; but it prevails in the greatest plenty in the county of Lancaster and some others, in which it is raised or worked out from large openings on the sides of hills, high banks, or in the plain surface, and set thickly upon the land. The getting or digging of the material out of such places, is usually performed by means of strong iron mattocks, crows, spades, and wooden piles; large pieces being in some cases forced down, not without danger to the workmen, by driving in the piles or piles from above. This method is called *falling*. The work is extremely severe, and commonly done by the rod. The large clods thus forced down, break into small pieces, and are then filled into carts for the purpose.

Shell-marle, though it is not much attended to in any part of England, is frequently met with and dug up from various parts of Scotland, and employed on the land in great quantities, with much success. The pits and quarries of this sort are commonly wrought with much more facility than those of the others.

Pipe, and other kinds of fine clays, are dug and raised from a sort of pits or quarries, in large quantities, in many different counties. Near Wear Giffard, in Devonshire, much of the first sort is dug and sent coastwards, though not in such quantities as formerly. Brown potter's-clay is also raised and sent away in great abundance from the neighbourhood of Fremington. These sorts of clays are likewise found in much abundance in Berkshire, and still more fully in some of the midland districts, where the pits of them are wrought to a vast extent. They are articles of great importance and utility in several sorts of manufactures, and for which there is great demand in many instances.

Alum earth is a kind of stratified matter, which is met with and raised from pits and quarries in a number of different situations, and various parts of the kingdom. In some they are wrought to very considerable extents and advantages, but in others in far less degrees, and with much less success.

The strata of this earth are dug and got up in different manners

manners under different circumstances, but mostly by means of strong crows, picks, and other tools of a similar kind, being wrought in somewhat the same method as in the cases of marble. The business is usually executed by common labourers.

Fuller's-earth is another material of this nature, which is dug out of the ground from pits and quarries at different depths in several parts of the country. In some it is very abundant, and of a rich good quality, as in those of the middle and more northern parts of the island, forming an article of great use and demand in several branches of business. In others it is of a much less valuable nature, being far less in request. That which is found about Tillington, in Suffex, is consumed in the neighbouring fulling mills. The mills of this sort in Yorkshire, and other parts also, consume immense quantities. The material is raised from the places in which it is found in much the same way as many other earthy substances, but it seldom requires so much digging, as it is a far less hard matter.

Fuller's-earth was formerly got up from pits and quarries in the neighbourhood of Maidstone, in Kent, and much ground wrought over; but the beds of sand by which it is covered are of such depths, as to render the works of little value or importance.

Quarries and pits of mineral peat-earth are found in some districts, and much of the material dug up from them, and made use of when prepared upon land. The vale of Kennet, in Berkshire, contains vast quantities of it, as well as some other parts. It is a stratified substance which is dug from under the surface at the depth of from one to six feet, laying below strata of small shells and calcareous matter. In raising it, a peculiar kind of spade is made use of, which cuts it in long pains, something like soap, which, when dry, are burnt into ashes and laid on the land. This substance is found to contain the oxyd of iron, gypsum, and the muriates of sulphur and potash, in the proportions of forty-eight, thirty-two, and twenty parts to that of one hundred.

It is suggested by the writer of the work on "Landed Property," that in most mountainous districts, and many low fenny counties, immense collections of vegetable mould or peat-earth lie in a state of neglect; even in places where they might be converted to valuable purposes; not only as sources of fuel merely, but as manure, either using the vegetable matter in its raw state, or after being reduced to ashes. In all these situations it might be readily dug up from different places, and applied to different uses in each of these ways, the pits or other spots containing it working in a very easy manner. The ashes of it are only employed on any large scale in the above county.

Culm, coal, and cannel, are articles of the fuel kind, which are found in a vast number of places, all over the kingdom in pits, mines, or quarries, and which are of the greatest importance in many of them. Speaking of coals, the author of the work on "Landed Property," considers them as rising in the minds of most men, far superior to most other productions and subterraneous matters, whether they are held in the light of agriculture, manufactures, or national defence. It is asked, if it were not for the collieries of this country, how many hundred thousand acres of its land, which are now appropriated to cultivation, would be required for the production of fuel? How many manufactories, especially those of iron, which are so very valuable to civilized society, would be cramped, retarded, and stopped, in their progress and operations? And how many hardy seamen would be wanting to its navy? Surely, in his opinion, an indigenous production and material, on which

the prosperity of the country so greatly depends, is entitled to the guardian care of its government; to ascertain the present expenditure, and the probable stock which is remaining. Let us not, it is remarked, play the spendthrift, and, by the follies of a day, entail centuries of want on generations to come, and the curses of millions on the memory of the present times.

In endeavouring to find these sorts of substances in parts where pits of them have not yet been wrought, the searching, it is supposed by the same writer, should, in general, be done by the land proprietors of the particular places, in a conjoint manner. There are, however, certain instances, in which individuals may prosecute the search with propriety, and in the most beneficial manner. In doing which, the principal things to be guarded against are those of misjudgment and impolition. Hence the necessary prudence of endeavouring to procure persons of skill and integrity for making such searches; which are, in the first place, to be attempted by a close investigation of superficial appearances, and then where those are favourable in their nature, by the use of the boring rod or tool. It is supposed that, at present, there are none who are equal to such undertakings, except those who have been long conversant with the business of coal-works; men who have an interest in the existing collieries or works of that kind. On this account it is thought to become a matter of common prudence, in a given situation, to endeavour to procure an undertaker or overlooker from a distant work; or such a one as can have no counter-interest to that of his employer; and then, closely to connect and bind them in one common interest. After having had different occasions for considering the subject, and for bestowing no small thought upon it, the writer is of opinion that the most eligible plan of proceeding, in such cases, is that of agreeing with an overlooker, or undertaker, to pay him reasonably, but not extravagantly, for his time, and for his actual expenses in prosecuting the necessary searches; and, further, to agree to give him, in the event of success, a reward sufficient to call forth his best exertions; such reward to be payable, not on finding coal, but whenever the work, to be established in consequence of the discovery, shall have cleared the amount. In this way the proprietor will feel himself secure, while the person employed has the most powerful stimulus to industry, attention, and the accomplishment of the object of the undertaking.

Culm and coal have been met with and wrought in some degree, in Devonshire, Suffex, and some other of the southern parts of the island; but they exist much more plentifully in the midland and more northern districts, as well as in some places in Wales and Scotland. In Gloucestershire, coal abounds in most parts of the forest of Dean, and its vicinities, and probably to within a small distance of the county-town, as at Newent and Pauntley, where pits are established. Those of the forest tracts are very numerous, but not fully wrought for want of sufficient draining. Pits of this kind also exist in many places, in the lower vale part of the county. In this district, however, the coals are no where of the best quality.

In the counties of Salop and Somershet, coals also prevail very much, various pits of them in both, being wrought to considerable extent. Those in the northern part of the latter district, have strata of them which form an inclination of the plane of about nine inches in the yard; and are nineteen in number. They are seldom wrought where less than fifteen inches in thickness, but they vary from ten inches to upwards of three feet. The working is performed at considerable depths, especially since the establishment of improved machinery, and other means for raising them. The coal

coal is of the first quality, being pure and durable in burning, and from its firmness, largeness, and strength of grain, capable of being conveyed to any distance without injury. At present the quantity raised in these pits, is from fifteen hundred to two thousand tons weekly, but much greater supplies could be afforded, if they were wanted. The works are twenty-six in number, some of which afford a good profit.

The pits in the southern part are upon a more limited scale of work. In them the strata of coal form an inclination of the plane of from eighteen to thirty inches in the yard; but in some it is destroyed, and they descend in a perpendicular manner. There are, in number, twenty-five, which are in thicknesses from six inches to seven feet, being rarely wrought under eighteen inches. The depth of working is middling, but will be increased. The quality of the coal not the best, but tolerably good. The quantity now raised from these pits is from eight hundred to a thousand tons in the week, which might be easily extended. The working profits are by no means great. There are pits in other parts, but they are not many, or much wrought.

Against the apprehension of pits of this nature being exhausted or worn out in these places, it is contended that more than treble the present quantity is capable of being raised from the works already carried on, and that this increased quantity might be supplied for several hundred years to come.

The works and quantities of coals contained in the counties of Stafford, Derby, and Nottingham, are likewise very great, and mostly of good kinds; pits of them being carried on in many places to vast extent.

Cheshire, too, is a coal district, in which a great variety of works for raising it are established in different parts, and much of it, which is of a very good quality, gotten up. The strata of coal here in many cases are several feet in thickness; about Wirrall the seam is five or six feet thick, and the works extensive under the channel of the Dee. In some works the beds of coal lie at the depth of from seventy to one hundred yards below the surface of the ground, and are of different thicknesses to ten feet or more.

In Lancashire, coal of good sorts is most abundant. The beds of it run across the county in somewhat three different parts, as towards the south, nearly in the middle, and on the north-east part. Those in the two first are of considerable breadths and thicknesses in different parts, but the third is much less broad and very thin in many places. They all run, in some degree, from the north-east to the south-west, constantly keeping somewhat the same direction, though occasionally branching out in a lateral manner to some extent. The works on each of these different lines of coal strata, especially the two most towards the south, are very numerous, and, in different instances, of very considerable extent. There are some also established on the northern line, but they are of a far more limited nature. The layers or strata of the coals are of various widths, from a few yards to a very great distance, and their depths or thicknesses from a few inches to six or seven feet. They lie at very different depths from the surface of the earth, according to circumstances and situation; on the eastern side of the county they sometimes nearly appear on the top of the ground, while in the middle, and towards the south-west, they are often a considerable number of yards deep. All about most of the large towns in the southern parts of the district very extensive works are established, where immense quantities of coals are raised for home use, as well as being sent coastways, and, in some cases, for exportation. They are a sort of material which is of vast importance to

the manufacturing state of the county, and which contributes greatly to its prosperity. The quantity is so great, when considered as a whole, that they would seem to be almost inexhaustible.

The cannel coal, which is a sort that has some resemblance to fine black marble, is principally found and raised in the tract about Haigh, near Wigan, which is not more than a few miles square. It lies in pretty thick strata, at the depth of from five to seven or eight yards from the surface. It is of a very fine, hard, inflammable quality, being got up by sharp picks, often with considerable labour, and for which there is much demand, for domestic use, in the neighbourhood.

Coals also abound in the neighbouring counties of Cumberland and Northumberland, being found in many parts of the eastern mountains, and, with not many exceptions, all along the tract, which extends in different degrees of breadth, from Sebergham to Whitehaven, and along the coast to Maryport, forming and comprehending a district of about one hundred square miles, in the former. And they are met with in great plenty throughout the greater part of the latter county, particularly in the lower district of it; being of the best quality, and the most numerous, and thickest seams, in the south-east quarter; whence those vast quantities are exported which supply the great consumption of the London market, as well as the coaling and foreign trade. A trade which is the foundation of the commerce of the country, and the principal source of its wealth, as well as a never failing nursery for some of the best seamen of the British navy. The former county has likewise works which supply prodigious quantities, both for home consumption and the coastways and export trade. Cannel coal is also raised in this district in pretty large supplies in the neighbourhoods of Caldbeck and Bolton.

Large portions of this article are likewise raised from the works in the county of Durham, which in some parts are carried on with much spirit and enterprise.

Coals are found, and raised in full supplies, in many places, in most of the counties of Scotland, so far as Perthshire; but they have not been met with any farther towards the north in any sufficient quantities. Where they exist, to any extent, in these situations, they are generally of good kinds, and capable of being got up without any great difficulty, seldom lying at any very great depth below the surface.

It has been contended by some, that the coals in the pits and other places, in this country, are inexhaustible, while others maintain the contrary to be the case; as the matter relates to the county of Northumberland, we have the following calculations, on the authority of the writers of the Agricultural Report of that district. And they may perhaps equally apply to others. It is supposed, that towards elucidating this point, it may be of some use to estimate what number of acres are wrought yearly in the county to supply the necessary consumption. In order to accomplish this object, the thickness and number of workable seams of coal must be first ascertained; for which purpose they have been favoured with sections, exhibiting the thickness and depth of the various strata, in some of the deepest pits in the county, one of which has a depth of two hundred and seven yards, with sixteen seams of coals; the other a depth of two hundred and forty yards, with fifteen seams; consequently, if the medium be taken betwixt the two, it will be nearly six yards thick of workable coal; from which may be formed, it is thought, a calculation of the quantity of coal in an acre of ground, supposing the aggregate thickness of the various seams amount to six yards.

An

QUARRY.

An acre of ground contains 4840 square yards,
 which, multiplied by the thickness 6 yards,
 gives 29040 cubic yards in
 From which deduct 30 for waste and
 the parts or pillars necessary to be } 9680
 left in working

there remains 19360 cubic yards to
 be wrought.

And as three cubic yards of coal, when wrought, afford
 a Newcastle chaldron, therefore

19360 = gives 6453 Newcastle chal-
 drons per acre,

divided by 3

The coals exported yearly from the rivers Tyne and
 Wear, with Hartley and Blyth, amount to about 825,000
 chaldrons, which, with the home-consumption of the two
 counties of Northumberland and Durham, will make the
 quantity of coals raised yearly about 1,000,000 chaldrons.

And the chaldrons } 1,000,000 = gives 155 acres nearly
 raised yearly } per year, cleared of
 divided by the chal- } 6453 coal six yards thick.
 drons per acre }

And by estimating the breadth occupied by the caking
 coals to be on the average eight miles broad, and twenty-five
 miles long in the two counties, it is found that there will be
 about two hundred square miles, or 128,000 acres of coal
 proper for exportation.

From Newcastle 510,000 chaldrons.
 — Sunderland 315,000 ditto.

In all 825,000

Then the whole area 128,000 = 825 years. The time
 divided by the } before this space will
 yearly consump- } 155 be wrought out.
 tion }

It is, however, suggested, that there are some reasons to
 suppose that a thickness of seam equal to six yards will not
 be obtained all over an extent of two hundred square miles,
 probably not more, on an average, than four yards; in
 which case the coal will be exhausted in five hundred and
 fifty years. And if the aggregate thickness of the seams
 to be obtained should prove only three yards, then little
 more than four hundred will be the term of continuance;
 but it is probable, it is thought, that before the half of
 that time be elapsed, the price to the consumer will be con-
 siderably increased from the increased expence of obtaining
 them, and the increased length of carriage from the pits to
 the rivers; this last, it is presumed, may be reduced in some
 situations, by adopting canals instead of waggon-ways,
 which, it has often been wondered at, have never yet been
 attempted. From this investigation, it is suggested, that
 the apprehensions of exhaustion are not so chimerical as they
 have been supposed and represented to be by some persons.
 When, however, the vast extent of the working and un-
 wrought tracts, in the different parts of the country, are
 considered, there cannot be any grounds for fear, in this
 respect, for a vast length of time yet to come.

Pits, some what of the quarry kind, are wrought in one
 district of this country, that of Cheshire, for the raising of
 rock salt, in some of which large quantities of this material
 are procured, from different depths, and different thick-
 nesses of the strata of it. In the getting of it different
 means are employed, as those of blasting, picking with im-
 plements, for the purpose of roofing, the using of horses,
 and machinery wrought by steam, for forcing up the sub-

stance, and some others. The digging, raising, and work-
 ing of this article, employs a great number of labourers, and
 it is of much importance to the county in many points of
 view.

But though this sort of material is found in several dif-
 ferent parts of the county, pits, or shafts of it, are at this
 time only wrought in the vicinity of the town of North-
 wich. This arises from a great many different causes, but
 principally from that of the want of water-carriage for the
 conveyance of the material from them. The number of
 pits or shafts, which there are at this time in work, for
 the purpose of raising this article, are about a dozen. They
 are by much the most commonly made in something of the
 square form, being secured on the sides by means of strong
 timber, but they have occasionally a round form, and are
 walled on the sides with bricks.

The beds of this material, that are to be raised, are
 wrought at various depths, the deepest being in general the
 most pure, and they vary equally in their thickness and
 directions, as suggested above. In some cases the beds are
 of the greatest thickness, the more they approach the
 north-east, decreasing in a gradual manner, in their course
 to the south-west; and in some instances they incline from
 north-west to south-east, dipping at the rate of about three
 feet in twenty-seven or thirty.

The strata, which are passed through in getting at and
 working the rock-salt, lie in a very regular manner, and
 consist, in general, of a hard clayey substance and a sort
 of gypseous material in mixture in various ways and pro-
 portions, that of the latter kind being the most predomi-
 nant as the pit or shaft approaches the rocky saline sub-
 stance. In working, the clayey matter is designated by
 the name of *metal* of the several different colours belonging
 to that sort of substance, and the other material by that
 of *plaster*. These strata are mostly of a solid compact
 nature, but occasionally broken in particular places, when
 the metal is termed *shaggy* by the workmen.

In the business of working the pits, and raising the rock-
 salt, the rocky beds are reduced into pieces of proper sizes
 for the purpose, by means of blowing them with gun-
 powder, and those of splitting and dividing them with ham-
 mers and proper wedges for such uses; a good secure head-
 way or roofing being constantly provided in the first place,
 to the opening from which the salt-rock is to be taken,
 which is effected by the use of small sharp picks, carrying
 on the work in a plain simple chambering manner.

The workings are sunk from these chamberings to dif-
 ferent depths, as the nature of the beds of rock, and the
 quantity of the purer kind of rock-salt, or Prussian rock,
 as the workmen term it, may direct; but commonly about
 fifteen feet. Occasionally the roofs or headways of the
 pits or shafts are supported by considerable square pillars
 disposed in a somewhat regular manner, but in other cases
 they are wrought out in a sort of long openings, accord-
 ing as the workmen are inclined.

In getting the rock-salt, the workmen are paid by the
 ton at the rate usually of about two shillings, they finding
 the gunpowder and other tools.

In raising the salt from the pits or shafts, horses were
 formerly entirely made use of, but within these few years,
 recourse has been had to the improved steam-engine, as
 already noticed, though it is not yet generally employed at
 every pit. See ROCK-SALT, ROCK-SALT Pits, SALT, and
 SALT Brine Springs.

It is evident from the above account, that in whatever
 way they are considered, the quarries of different kinds
 in this country are of very material importance to its
 prosperity

prosperity and convenience; contributing largely to the carrying on of different sorts of works and improvements. Without them much useful labour must be wholly at a stand; a variety of necessary businesses be incapable of being carried on; and the effects of it upon various arts and manufactures, be much too serious to be thought upon. In short, the numerous substances of different kinds, which are taken from the bowels of the earth in this country, constitute one great source of our national wealth and prosperity.

QUARRIES, *Pits, &c. Draining of*, the proper, most convenient, and appropriate means of rendering all such sorts of works dry, free from water, and in a fit state to be wrought with ease and advantage. In the effectual performance of all kinds of undertakings of this nature, there is occasion for the application of the same principles, which are spoken of and explained in considering the nature of draining land in general, and the particular manner which is necessary to be pursued in the practice of spring draining. See *DRAINING of Land*, and *SPRING-Draining*.

There can be no doubt, indeed, but that the having recourse to such principles, and the modes of practice resulting from them, will be equally expeditious, beneficial, and successful, as well as in many situations of very material importance, in the various cases of this sort, as in those which have been mentioned; by leading to and introducing the most ready and easy means of diminishing the quantities of water, which are frequently met with in the course of working them, and which not unfrequently obstruct and hinder in a very high degree, but sometimes wholly put a stop to the work which is carrying on in them. Such, at least, is very often the case in quarries of the free-stone, lime-stone, flag-stone, marble, and other kinds, as well as in pits of the coal and other sorts. The want of this sort of knowledge, of course, is one great cause why such a number of quarries and works of that kind, in different parts, often lie altogether, or for a great length of time, in an unwrought state; which might otherwise be wrought to very great advantage.

As it is now well understood, that most springs and subterraneous collections of water are formed and supplied from such grounds or lands as lie higher than that of the places where they are found or met with, which, on account of their being of an open or porous nature, admit that of rain and other sorts of moisture to filtrate and pass freely through them, which sinking and descending to very great depths, through such open materials of the rocky, sandy, gravelly, and other loose qualities, before it becomes impeded and obstructed by some sort of impenetrable stratum or layer of an earthy or solid stony nature, such for instance as those of pure stiff clay or compact rock; it may happen, that in many such cases, in sinking pits or shafts for stone, coal, or any other kind of subterraneous material near the bottoms of hills or high grounds, beds of quicksand will be met with, and dug into, which are so full of water, that to pass through them becomes a most troublesome, difficult, and expensive piece of work, and sometimes impossible to be performed, but which, from knowing that the water proceeds from the porous ground that lies above, it may often be practicable to intercept and cut off the greater part of the water, before it reaches such sand beds in the quarries, pits, and shafts, by the means of boring into and tapping the water at the *tail* of the banks of this nature, provided that the ground naturally declines lower than the place where the sand is found in the quarries, pits, &c., and the whole or most of the water be drawn off, and diverted from them at a comparatively

trifling expence to that which is employed as the common remedy in such cases and circumstances.

In order to accomplish this intention, it will be necessary, in ascending from the quarry or pit, to carefully examine and ascertain, if at any place higher on the declivity, any porous stratum, bed of rock, sand, or gravel, *tails* out, which may conduct and convey the water contained in it to the sand bed, which is below in the works; and where any such bed is found, to cut or bore into it in such a manner as to form a drain, that is capable of carrying away the whole or the greatest part of the water, and of course to clear, or diminish the quantity contained in the quarry or pit, which would otherwise have continued to descend through such porous substrata or beds, and have continued to fill the sands, or quarries and pits.

But although this part of the business may have been accomplished, and the supply of water from the higher ground entirely cut off, a sufficient quantity to injure, hinder, and inconvenience the working of the quarries or pits, may yet continue to drain and ooze from the sides of the sand beds, notwithstanding they should happen to *dip* towards the lower ground, in which cases, however, that water may readily and with great ease be commonly drawn off at some particular point in it.

In order to effect this, and thereby remove the inconvenience of this filtrating water, in descending from the quarries or pits along the declivity, it should be endeavoured to discover and ascertain, at what particular point or place in the low ground, the sand terminates or *tails* out, which is mostly best accomplished by means of proper levelling; and if there should be there any appearance of the waters having a natural outlet, it may, by means of making in it a deep drain, be far more readily and effectually drawn off and removed; as springs, for the most part, naturally pass and flow through narrow, winding, convoluted openings, or perforations; of course, whenever the orifices or passages are opened, enlarged, or made lower than before, the discharge of water becomes greater and more expeditious. Where, however, there happens to be a deep impervious layer or covering of clay, or other matter of a similar nature, placed above or upon the termination or tail of the sand, the drain need only be cut down to it or a little way into it, as by means of boring through it, or the remaining portion of it, a ready and easy outlet or passage may be given to the whole of the water, that may be contained in the sand-bed or other porous stratum.

This mode of draining quarries and pits may often be of great utility, advantage, and convenience, as it will also, in a great degree, remove, or at any rate relieve, the trouble and difficulty that would afterwards have attended the sinking the quarry, pit, or shaft; as the water thus drawn or cut off, must of necessity diminish and reduce the quantity, which would have been found at a greater depth, the same body of it probably passing downwards from one stratum to another, as far as they continue to be porous, or capable of admitting it. Therefore, it is of very material importance to drain and lay dry all such ground as is situated higher, but contiguous to quarries, pits, or other deep subterraneous works of the same kind, for the above stated reasons. And it may, in general, be accomplished with but little trouble, difficulty, or expence, by adopting the same principles, and the same means.

But in regard to the removal of the water found and contained in the bottoms of such quarries, pits, or deep works, it must be drained off and got rid of in quite a different manner, as the level of the ground may probably be, or decline, nowhere lower than the mouths or openings of such quarries,

pits, &c.; as it is solely and particularly on the supposition, and in such cases as where the direction of the different strata and sand-beds have a *dipping* position with the natural inclination of the surface of the land, or lie nearly horizontally, that the method of proceeding which is stated above is practicable, or capable of being employed with any sort of advantage. But should they, for instance, lie in a reverse or contrary direction, there is but little possibility or chance of accomplishing the object, the removal of the water, unless by discovering or hitting on their terminations, somewhere on the opposite sides of the hills or elevations, which in some cases may very nearly or exactly be found out, by ascertaining the precise inclination or direction of the materials of the quarries, pits, &c. and by a careful and exact use of the level. But this will be much better comprehended, and a more clear, full, and perfect notion of its nature be afforded, by the section figure in the plate on draining quarries, pits, &c. in agriculture, as given by Mr. Elkington, in his work on that subject.

This is the manner which is to be pursued in preventing the effects of water, or cutting off that which is met with in sinking the quarries, pits, shafts, or other similar works, before reaching or arriving at the stone, coal, or other sort of material that may be wanted; but that which is found in the bottoms of these different kinds of undertakings, or which proceeds from the rocks or their sides, or in other ways, in the course of working them, is commonly got quit of by means of some sort of machinery, as that of the engine or other kind of pump, in order to assist in working of which, the water gained by cutting the drains already noticed may be particularly useful, especially where the usual stream for that purpose is insufficient in saving the great expence of working such machinery by the power of steam. But without the aid of a natural stream, which is capable of being converted to this purpose, it is rarely possible to find, by means of drains, or in any other way, a quantity of water sufficient to drive such weighty machinery, in a situation of proper height, to have the full and necessary command of it. However, in many cases it may be an acquisition of great utility and value. It is explained at *fig. 2.* in the same plate.

In some situations, where a full and proper command of water can be had, and where the entrance to the quarry, pit, shaft, &c. is also suitable for the purpose, the use to which it may be converted and applied is still more important and advantageous, as the driving of machinery for bringing out the various kinds of materials, and at the same time working an engine-pump, in order to clear the works of the subterraneous water which flows from the cavities of the rocks, which are met with in working these sorts of pits, &c.

It has been remarked in Mr. Elkington's work on draining, in these cases, that the duke of Buccleugh's coal-works, near Langholm, in the county of Dumfries, afford a striking example of this, as well as of the superior powers of water and machinery, when properly combined, where a command of the former can be had, and when the latter is constructed on proper principles, and conducted with that care and ingenuity which are requisite in such difficult undertakings.

In working quarries of lime-stone, free-stone, and other sorts of materials, it not unfrequently happens, that, at a certain depth, part of the rock or other body, which contains the water, is hit upon, by which they are soon so filled with it, as completely to put a stop to the work proceeding any deeper, where the best and often the greatest part of the stone is situated. In all such cases, the most usual remedies have been, either the erection of a wind-mill pump, to draw out part of the water, as the whole cannot be taken away by such means, or the opening of a new quarry or pit

contiguous to the other, which at the same depth mostly meets with a similar obstruction, or the bringing up of a very deep cut, often at great expence, under the level of the water, from the nearest declivity or hollow that can be met with. However, by the following method, all quarries of lime-stone, free-stone, marble, or other materials of the same nature, which are liable to such sort of obstruction, may be completely and effectually cleared of the water at but little expence; while, at the same time, the drain which is made may serve the double purpose of that, and the laying of the wet ground, caused by the spring contained in the rock, which is found contiguous to it, dry.

There commonly lies, immediately under the rock, a bed of strong, stiff, retentive clay, which upholds all the water received and retained by that rocky stratum, and which being, at the same time, bound round on each side by a covering of the same sort of clayey material, or other stiff earthy substance, is not able to discharge itself, and of course constantly remains or stands full in the rock, so as to prevent the working or taking out the stone from the bottom.

In such cases it is necessary, in the first place, to endeavour to find to what side the rock *dips* or inclines, which, in general, may easily be ascertained by the appearance of the surface, in examining the surrounding ground, and the aid of a proper level. When this has been discovered and fully ascertained, a suitable drain must be cut through the clayey covering to the rock, by which the water will be drawn off, which, for want of a proper outlet, formerly stood pent up in the hollows and cavities of the stony stratum or body. This is further and more fully explained by *figs. 3 and 4.* in the same plate.

But, in some cases, this sort of evil or inconvenience may be removed and remedied in a different way. As it frequently happens that a bed or body of the same stone, which has a close, compact nature or quality, is found lying under one which has a more open porous texture, with fissures and cracks in it, that are admissible of water, which obstructs and keeps up the water in the upper bed or layer, in such a manner, that not any of it can pass or filtrate through it to an inferior, or still deeper open stratum or bed; and on sinking or cutting through this compact bed of stone, another layer is met with, which is of so open and porous a nature, as to admit the reception of any water from the above one, which may come upon it.

And sometimes a bed of gravel or sand is found under that of the close stone, which being still more capable of absorbing or taking up any water that may be let down to it, is far better and more properly suited for the purpose of clearing the upper bed of stone from water, than a stratum of open stone itself.

Therefore, when this is discovered and ascertained to be the case, and the water is *kept up* by the second bed of stone, so as to be injurious and hurtful to the working of the upper bed, and which will be equally so in working the second; the work may be greatly freed and relieved by boring through the close bed of stone, and letting down the water into the more porous one below, or into a stratum or body of dry sand or gravel, should there be such a one underneath it. But in place of boring, the sinking of small pits through the close stone is a more effectual method of letting down the water, though a much more difficult one in the execution.

The methods of digging and boring, even in the bottoms of quarries, pits, and shafts, where pumps and other machinery of the same nature are made use of, as has been noticed above, may, in some cases, not only be practicable, but advantageous for letting down the water which they contain into an inferior open stratum.

That

That of boring has been practised with complete success in the case of a colliery in the county of York, which had been wrought many years, and in which the water was raised about sixty yards by a steam-engine: the proprietors of which, on boring down from the bottom of the pit next to the engine-pit, to the further depth of about ten yards, in order to ascertain the depth or thickness of a seam of coals, which was supposed to lie below those then wrought; the workmen, on taking out the boring rods, found that the water from the works, which usually ran across the bottom of this pit to the engine-pump, now ran down the holes they had made. And that the steam-engine pump, on being set to work, contained little or no water, it having escaped through these holes, and continued to run through the same ever afterwards, rendering the pump useless. It is remarked, that this instance of water at so great a depth from the surface, finding a passage at a further depth of ten yards, or less, and immediately below, is extremely singular and striking in its nature. The situation was much higher than the nearest contiguous vallies, or the level of the sea. Trials of this sort can seldom be made, therefore the cases are rare, uncommon, and curious. But in extensive tracts of level land, where lakes or morasses have been formed, and which cannot be laid dry by cutting open drains, or driving levels through rocks, except at an expence for which the lands, when drained, would never compensate, the above instances warrant the trial of experiments with boring rods, which, if not attended with success, can be made at little expence.

In the county of Lancaster, about the town of Ormskirk, as well as in some other parts, stone quarries are cleared of water exactly in the manner which has been already pointed out, but which *fig. 5.* in the plate will explain much better.

The success of the practice has likewise been farther shewn by the late T. Eccleston, esq. of Scarrisbrick-hall, an ingenious and extensive proprietor of land in the same neighbourhood, who remarks, that in stone quarries thereabouts, wells or pits are occasionally sunk to the open bed, which have proved serviceable. This mode was practised in a stone delf near the above town in a very beneficial manner. But in order to lay the delf more effectually dry to a greater depth, Mr. Elkington, on viewing the surrounding ground, marked out where he thought the rock terminated, or tailed out, and at the lowest level set out a drain to be cut and carried up to the rock, part of which work has been executed, and a very considerable flow of water comes from it; but on account of its great depth, sixteen feet, the whole will not be finished before he has seen the work again. The drain he has thus laid out is about ten feet lower than the bottom of the stone quarry, and when completed, will lay the head or body of stone dry lower than the present floor. All rocks, for the most part, where they terminate, are succeeded by broken loose stones of the same nature as the rock, and they are frequently, nay almost always, succeeded by sand, which, when in a thick bed, and of a running nature, such as quicksand, often cause great expence in cutting through to the tail end of any rock. This is more fully explained in speaking of the manner of draining in hilly lands, and where the soils are of a mixed nature. See *SPRING-Draining*.

Therefore, in all such cases as this, where there is any danger of meeting a quicksand, boring or sinking pits through the bed of close stone, is by much the most advisable, and at the same time the least expensive method that can be pursued.

The situations of marle pits are for the most part such, that they require very extensive cuts to be made through

some parts of the surrounding banks or sides of them, in order to carry or convey off the superabundant quantity of water which prevents their being dug or wrought to advantage. This business might frequently be effected in a much less troublesome and expensive manner, by the method of letting the water down by means of sinking pits or openings through the retaining and upholding stratum underneath the bed of marle, into some absorbent porous body of materials lying still deeper, which is capable of receiving it. Where the space of ground that is occupied by the marle is of considerable size, several pits will be required, in order to effectually carry off the water; and where it is necessary that they should be so deep as to be in danger of falling in, they ought to be walled round the sides, or filled up to near the top with loose stones, through which the water can settle and find its way. And any such cross drains or cuts as may be necessary for the purpose of collecting the water must be so formed and conducted as to lead into the pits. But in many cases the water may be removed and got rid of in a still more easy manner, especially where the situation of the ground is favourable and suited to the purpose. In instances where the surrounding banks decline or fall on the opposite sides *lower than the water*, by cutting drains into them, and boring with an horizontal auger into the tails of the strata containing the water, it may be drawn off and brought down to a level lower than that of the bed or body of marle. And as this water is not unfrequently supplied by a spring which rises in some part of the higher ground, and descends into the place where the marle is found, it will be necessary, in all such cases, to cut off the source of it, and divert the flow of water into some other channel; as by that means the quantity of water below will be lessened, and more easily and readily carried off by the pits or drains which may have been formed.

Mines and shafts, for the purpose of raising different sorts of metals, are often much impeded, or wholly prevented from being wrought by the water which is brought into them from a distance, by various kinds of mineral strata. In many such cases, the water flowing in this way may be intercepted, by making cuts up to the lowest banks of them, from some neighbouring water-course, or other convenient outlet, and then boring or digging pits in the bottoms of such cuts, when the metals to such depths or levels will be rendered free from water, and capable of being wrought. This will, however, be more amply shewn in considering the manner of draining, in some cases of wetness, caused by springs arising in this way. See *SPRING-Draining*.

In removing the water, or freeing the bottoms of quarries and pits from it, where machinery is required, the writer of the work on "Landed Property" has remarked, that in cases where *shaft-drains* are found to be impracticable, *well-drains* and pumps become necessary, and are the most proper; as they may be wrought by water, where streams can be conducted to them; or by wind in high exposed situations; or in works of consequence, where fuel is moderately cheap, by small steam-engines. However, in instances where large bodies of water are required to be raised and discharged at the height of a few feet only, marle-mills, such as are made use of in low marsh-land districts, are found the readiest and most useful kind of machinery for the purpose.

In some cases of this nature, the bottoms of quarries, pits, and mines, may be cleared from water, simply by forming openings into them from some parts of the neighbouring ground where it falls lower than the levels of them, at sufficiently short distances, without any other more expensive works being undertaken for the purpose. This should always be fully considered before any means are resorted to

for laying them dry, as it may occasionally be the saving of much labour, trouble, and money.

QUARRY, in *Glazery*, a pane, or piece of glass, cut in a lozenge, or diamond-form.

The word seems formed by corruption, from *quarrel*, (which see); unless we will suppose it to come immediately from the French *quarre*, *square*.

Quarries, or quarrels of glass, are of two kinds; viz. square and long, each of which is of different sizes, expressed by the number of pieces which make a foot of glass; viz. 8ths, 10ths, 12ths, 15ths, 18ths, and 20ths; but all the sizes are cut to the same angle, the acute angle being $77^{\circ} 19'$ in the square quarries, and $67^{\circ} 22'$ in the long ones.

QUARRY, in *Falconry*, is the game, or fowl, which the hawk is in pursuit of, or has killed.

QUARRY, among *Hunters*, is sometimes used for part of the viscera of the beast taken; given by way of reward to the hounds.

QUARRY-Cart, a name commonly given to that sort of cart which is principally employed in the work of quarries, and which is generally of a low, compact, strong kind, in its nature, form, and manner of construction, in order to sustain heavy weights, and receive them without difficulty, or the danger of being destroyed. Carts for this purpose should always be made of well-seasoned wood, be well put together, and have sufficient strength of timber in those parts where the main stress of the load is placed. See CART.

Some quarry counties have well-formed carts of this nature, as many of those towards the northern boundaries of the kingdom.

QUARRY-Wagon, or Truck, a small carriage of the low truck kind, which is much employed in the business of quarries, especially those of the slate kinds, for the purpose of holding and conveying the rough materials, which have been blown from the large massy rocks, or separated in other ways, out of or from the quarries and pits in which they are situated and contained, to the places where they are to receive their different preparations and shapes.

It is formed and constructed on a frame somewhat similar to that of the common barrow, and mounted on two low light iron wheels on the fore part, having two feet behind, projecting from the frame, bent something in the manner of the letter S, and of sufficient length to let it stand or rest in a horizontal position while it is in the act of being loaded. These feet are usually made of iron, but they may be formed of other materials. A sort of inclined plain is formed from the bottoms of the quarries or pits, up which it is forced, with great ease and facility, by the workmen, or small animals of the horse kind, after being filled with these sorts of heavy materials. It is a very useful and convenient machine in this application, being met with in most of the slate quarries in the northern part of Lancashire, as well as in those of many other districts of the kingdom.

QUARRYING, the business of directing and conducting the nature and management of sinking the different kinds of quarries, pits, and shafts, as well as of the different sorts of work which are necessary to be undertaken, carried on, and performed, in the several different descriptions of them; such as those of separating, getting up, and preparing the various sorts of materials for use in the arts, or in other ways. It is a practice which requires considerable knowledge and experience, to be fully master of it in all its different bearings and intentions. See QUARRY, and QUARRYING *Slates and Stones*.

Almost every sort of quarrying-work requires a different kind of management, not only in the opening and sinking

the quarries and pits in the grounds at first, but afterwards in the methods and practices of working them, and getting up the various sorts of materials from them, as well as in the modes of preparing, trimming, and arranging them, after they have been raised. They are, however, mostly well known and familiar to the quarry-men and pit-men who are usually engaged in works of the several different kinds.

QUARRYING *Slates and Stones*, the methods of preparing and fitting them for their different uses and applications at the quarries and pits where they have been raised. The former of these articles, particularly those of the blue, green, and purple or blackish kinds, undergo several different sorts of preparation in the quarrying, according to the purposes to which they are to be afterwards applied. They are separated and divided into very thin pieces or slates, where light, neat coverings are required, or in much demand; but for more strong and heavy coverings, in exposed situations, or other places, they are split into much thicker sheets, layers, or slates, and are, of course, more clumsy in their appearance.

Each sort in the business of quarrying is wrought in a separate manner, and packed up by itself; the different sorts having appropriate names, as has been already seen.

The white or brown slates are never divided and prepared in so fine a way as the other kinds, but separated into much thicker flakes or laminæ, in this intention. The blue, green, and purple or darkish sorts, are, for the most part, found capable of being split into very thin laminæ or sheets; but those of the white, or brownish free-stone kinds, can seldom be separated or divided in any very thin manner, as the layers of the large masses of the stones are of a much thicker nature, they consequently form heavy, strong, thick coverings, proper for buildings in exposed climates and situations, and of the more rough kinds, such as barns, stables, and other sorts of out-houses.

In the different operations and processes of this sort of quarrying, slate knives, axes, bars, and wedges are chiefly made use of in the different intentions of splitting and cleaning the slates, they being separated into proper thicknesses by the axe, bar, and wedge, and afterwards chipped into their proper forms and shapes by the knife. All the different inequalities which may appear upon any part of them, are likewise removed by this last sort of implement.

In the quarrying of the latter sorts of materials, or those of stones, the work is usually performed in such a manner as to suit the different uses for which they are intended. Where flags are to be formed, they are split or riven into suitable thicknesses, and squared to different sizes, so as to be adapted to different applications. These operations are executed in rather a rough way, as they are afterwards to be finished by the stone-mason. When for steps, they have the proper breadths and depths given to them in a sort of squaring manner, being left to be completed as they may be wanted for particular uses and applications. Gate-posts are, for the most part, quarried so as to have from about a foot to a foot and a half or more in the square. Trough-stones have the quarrying performed so as to be formed into various proper-sized squares or other forms, in a rough manner, being left in these slates to be afterwards hewn and hollowed out, in the intended parts, by the stone-masons.

Stones for building purposes are usually raised and quarried out roughly into something of the square shape, being left in that state for the builders, who afterwards fit them so as to suit their own purposes and intentions.

In the quarrying of stones, the quarrymen commonly make use of large hammers, with cutting ends on one side, the other being formed in a plain manner; strong, sharp, crow-bars,

bars, and broad, sharp, iron wedges; by which means these matters are, from the constant practice of the men, split and torn into such forms as are wanted with great ease and facility. See QUARRY.

QUARRYING Tools, the different sorts of implements which are employed or made use of in the different works of this kind, as in the raising and preparing the various sorts of materials of this nature. They are principally such as those which have been noticed already, and different descriptions of picks, mattocks, and jumpers, or boring implements, for the purpose of blasting the various kinds of stone, and other hard materials. These tools are individually described under their particular heads. See each of them.

QUARRYINGS, the small pieces which are broken or chipped off from the different sorts of materials which are found and wrought in quarries, while they are undergoing their different preparations for various uses. These substances, where they are of the hard kind, such as those of the blue and lime-stone, as well as some other sorts, are extremely well calculated for the purpose of forming and repairing roads, as they are nearly, if not quite, in a state fit for immediate application in this way. Materials of these kinds ought, therefore, where they can be conveniently had, never to be neglected by those who have the care and management of roads, as they will save much expence and trouble, in a great number of instances. See ROADS.

QUART, *q. d.* fourth, in *Music*. See QUARTE.

QUART is particularly used for a diminutive measure, containing one-fourth, or quarter, of some other *measure*; which see.

The English quart is a fourth of a gallon, or two pints; the Roman quart, or quartarius, was the fourth part of their congius.

The committee appointed for examining the standards of weights and measures, and ascertaining those that shall be used in this kingdom, delivered it as their opinion, in their report to the house of commons, A. D. 1814, that the gallon ought to contain 10 pounds of pure water, or 276.48 cubical inches; that the quart, or fourth part of the gallon, ought to contain 40 ounces of water, or 69.12 cubical inches; and that the pint, or half of the quart, ought to contain 20 ounces of water, or 34.56 cubical inches.

The French, from whom we borrow the word, besides their quart, or pot of two pints, have various other quarts, distinguished by the whole of which they are quarters; as *quart de muid*, and *quart de boisseau*. See MUID, and BUSHEL.

QUART of Butter, in *Rural Economy*, a name given to a lump which contains the quantity of three pounds; and which is a mode of felling it that is peculiar to some districts, it being carried in this state to the markets.

QUART de Soupir, in *Fr. Music*, is a rest equal to a semi-quaver. By a 4th part of a soupir is meant an equivalent to a double croche, or two quavers in French, and one crotchet in English. See TIME-TABLE, and VALUE of NOTES.

QUART de Ton, *Fr.*, a quarter of a tone, an interval introduced into the enharmonic genus by Aristoxenus. We have neither ear nor harmonic calculations that can furnish us with the exact interval or ratio of a quarter-tone; and when we consider what nice geometric operations are necessary to settle it on the monochord, we are very apt to suspect that this true quarter-tone never has been nor ever will be produced exactly in tune either vocally or instrumentally. Musicians, however, call the difference between A $\sharp$ and B $\flat$, a quarter-tone, an interval which, though in nature, is annihilated by temperament.

This quarter-tone is pretended to be of two kinds; the enharmonic major, in the ratio of 576 to 625, which is the

complement of two minor semitones to a tone major; and the enharmonic minor, in the ratio of 125 to 128, which is the complement of the same two minor semitones to the minor tone. Rousseau.

QUARTAN, in *Medicine*, an ague or intermittent fever, the paroxysms of which recur every third day, leaving two intervening days without fever. This is vulgarly called a *third-day ague*; but in medical language it is termed quartan, or *fourth-day ague*, because if we reckon the day on which the disease commences as *one*, then the second paroxysm is on the *fourth* day, which again becomes *one* in relation to the succeeding paroxysms. See FEVER, Quartan, and AGUE. See also TERTIAN.

QUARTARIUS, a measure among the ancients, being the fourth part of a sextary, and nearly equal to a quarter of a pint of our wine-measure.

QUARTARO, in *Commerce*, a liquid measure at Venice. The amphora, which is a wine-measure, contains 4 bigoncio; a bigoncia 4 quartari, 16 seechie, or 256lb. Pefo grosso; but a bigoncia of brandy is only 14 seechie, or 56lb. Kelly's Un. Cambist.

QUARTATION, in *Metallurgy*, is the separation of silver from gold by means of aqua fortis or nitric acid; which is an operation that has something singular in it.

If silver and gold are mixed together into a mass, and the gold is not less than one-third part of the mass in weight, the best aqua fortis poured upon it is not at all capable of dissolving the silver; but if you add more silver to this mass, by melting it again in the fire, with such a necessary addition of that metal alone as should bring the gold in the mass to the proportion of less than one-third of the whole, and suffer it to cool, then aqua fortis poured on it will corrode the silver from it; this is also by so much the more strongly performed, as the quantity of gold is less than in the proportion of one-third of the whole mass; but experience has taught us, that aqua fortis dissolves silver mixed with gold quickly enough when the gold constitutes but one, and the silver three parts of a mixed mass of them; and in this case, if the solution is not too impetuously performed, the gold usually remains in such a proportion, in the same figure that the whole mass had before the separation of the silver by this menstruum; so that, in this case, there is no reason to apprehend the gold's being torn into minute particles, and dissipated in some measure; though this can hardly be prevented when the silver exceeds the three-quarter proportion, in regard to the gold in the mass. The artificers, therefore, always make it their study to observe very exactly this proportion of the gold being one-fourth part of the mixture; and thence it is that the operation itself has been called quartation.

In order to ascertain nearly the proportion of gold and silver in a mass, the assayers rub this mass upon a touch-stone, so as to leave a mark upon it; and they then make marks upon the stone with some of those needles, called touch-needles, the colour of which they think comes nearest to that of the mass: by comparing the marks of these needles with the mark of the mass, they discover nearly the proportion of the gold and silver in the mass. The mass of gold and silver to be quartered ought previously to be granulated, by melting it in a crucible, and pouring it into a large vessel full of cold water, while at the same time a rapid circular motion is given to the water by quickly stirring it round with a stick or broom. The vessels generally used for this operation are called parting-glasses. The aqua fortis must be purified for this purpose, and should be so strong as to be capable of acting sensibly on silver when cold, but not so strong as to act violently. If it be very strong, and the vessels

well

well closed, a small quantity of the gold will be dissolved along with the silver, which is to be guarded against. Little heat ought to be applied at the beginning, the liquor being apt to swell and rise over the vessel; but when the acid is nearly saturated, the heat may be safely increased. When the solution ceases, which may be known by the discontinuance of the effervescence, or emission of air-bubbles, the liquor is to be poured off. If any grains appear entire, more aqua fortis must be added, that all the silver may be dissolved. If the operation has been performed slowly, the remaining gold will have still the form of distinct masses, which are to receive solidity and colour by putting them into a test under a muffle, and making them red-hot. If the operation has been performed hastily, the gold will have the appearance of a black mud or powder, which after five or six washings with pure water, must be melted. The silver is usually recovered by precipitating it from the aqua fortis by means of copper vessels, into which the liquor is poured, or of plates of copper, which are thrown along with the liquor into glass vessels. A considerable heat is required to accelerate this precipitation. Dr. Lewis observes, that when the aqua fortis has been perfectly saturated with silver, no precipitation is occasioned by plates of copper, till a drop or two of aqua fortis is added to the liquor, and then the precipitation begins, and continues as usual. The precipitated silver must be well washed in boiling water, and fused with some nitre, the use of which is to scify any cupreous particles which may adhere to the silver.

Here we may add, that silver and gold may be parted from one another by the vitriolic acid, as effectually, though not so commodiously, as by the nitrous. If the compound be reduced into grains or thin plates, and boiled in about twice its weight of oil of vitriol to dryness, the silver will be so far corroded, as to be easily washed off by a little more of the acid: or if the mass, after the corrosion, be melted in a crucible, the gold will separate and subside, the silver forming a scoria above it. Gold may be purified in the same manner from several other metallic bodies. M. Scheffer says, that this is the most direct way of separating tin from gold. Lewis's Com. Phil. Techn. 95. 149, &c. See ASSAYING, DEPART, and GOLD.

QUARTAUT, in *Commerce*, a wine measure in some parts of France: thus, at Blois, 3.74 quartauts are equal to 100 English gallons, and each of them contains 6183 cubic inches; in Burgundy, 3.68 quartauts are equal to 100 English gallons, and each contains 6275 cubic inches. Kelly's Un. Cam.

QUARTE, Fr., *Quarta*, Ital., the 4th in music, and the third consonance in point of perfection, according to the order in which concords are generated.

The 4th is a perfect concord; its ratio is 3 to 4. It is composed of three diatonic degrees, formed of four sounds; whence it has its name of fourth. Its interval is composed of two tones and a half: a tone major, a tone minor, and a major semitone.

The 4th may be altered two several ways: 1st, by diminishing its interval a semitone, and then it is called the diminished or false 4th; 2dly, by augmenting it a semitone, and then it is called a *tritonus*, or superfluous 4th. (See TRITONUS.) But the diminished 4th is never used in harmony, and only touched now and then in melody as an appoggiatura, or note of refinement.

The 4th in thorough-bass is accompanied by the $\frac{3}{2}$, and called by some the chord of the 11th.

Another chord is called the superfluous 4th, or tritonus, by the French; which is what we call the chord of the $\frac{7}{4}$,

or $\frac{7}{4}$, in which the discord is in the base; but it is not the chord of the tritonus, unless the 4th is sharp. See CHORD, and ACCOMPANIMENT.

The succession of two perfect 4ths is allowed in composition, even in similar motion, provided they are accompanied by the 6th; but these are passages that must not be abused, or pushed too far, as they are not authorized by the fundamental base. The Italians call a regular succession of chords of the 6th *falso bordone*; for which see FOURTH.

QUARTEEL, in *Commerce*, a measure for train-oil at Hamburgh: it contains 2 tonnes, or 64 stubgen, and is reckoned at 2 centners, or 224 lbs. net weight. Kelly.

QUARTELOIS, CARTELOIS, or *Cortuce*, surtouts, or upper garments, with coats of arms quartered on them, worn by the ancient knights in their military expeditions.

QUARTER, the fourth part of a whole, or integer divided into four equal portions.

In working of fractions, the quarter is expressed by $\frac{1}{4}$; three quarters by $\frac{3}{4}$.

QUARTER, as a *Weight*, is a fourth part of the quintal, or hundred-weight.

The quarter is 28 pounds avoirdupois.

QUARTER is also a dry measure, containing of corn eight bushels striked, or two sacks, being that by which corn is generally sold in the London market, and in large quantities in some districts of the country; and the quarter of coals is the fourth part of a chaldron, called a vat.

"Quarterium frumenti constat ex octo bussellis." Fleta, lib. ii. This seems to have signified originally the fourth part of a ton in weight, or capacity. See WEIGHT.

QUARTER, in *Astronomy*, the fourth part of the moon's period, or lunation, which is divided into four stages, or quarters; containing each from seven to eight days.

The first quarter is from the new moon to the quadrature; the second thence to the full moon, &c.

QUARTER, in *Heraldry*, is sometimes used for an escutcheon, or coat of arms.

In this sense there are sixteen quarters required to prove nobility, in companies, or orders, where none but nobles are admitted.

The word quarters, required as a proof of nobility, is derived hence, that they used anciently to put the coats of arms of the father, mother, grandfather, and grandmother, on the four corners of the tomb of the deceased.

In Flanders and Germany we frequently see tombs that have eight, sixteen, and even thirty-two quarters.

QUARTER is also applied to the parts or members of the first division of a coat that is quartered, or divided into four quarters. See QUARTERING.

The king of Great Britain, in the first quarter, bears gules three lions passant or, &c. In the second quarter he bears azure three fleurs-de-lis, &c.

QUARTER, *Franc*, is a quarter fingle, or alone; which is to possess one-fourth part of the field.

This makes one of the honourable ordinaries of a coat. See ORDINARY.

QUARTER, in *Law*, *Quarterium Anni*, is the fourth part of a year.

Hence the days on which those quarters statedly commence, are called quarter-days.

Quarter-days are the 25th of March, called Lady-day; the 24th of June, called Midsummer-day; the 29th of September, called Michaelmas-day; and the 25th of December, or Christmas-day.

QUARTER, Fr., in old counterpoint, was proceeding in disant by a succession of 4ths; which was called, in barbarous

barous Latin, *diatessaronare*; of which we have instances in the "Micrologus" of Guido.

QUARTER, in *Navigation*. A quarter of a point, wind, or rhumb, is the fourth part of a cardinal point, wind, or rhumb; or of the distance between two cardinal points, winds, &c.

The quarter contains an arc of 11 degrees 15 minutes.

The quarter is what Wollsius, with regard to the other divisions, calls a secondary point of the second order.

QUARTER of a Ship is that part of the ship's side which lies towards the stern; or which is comprehended between the aftmost end of the main chains and the sides of the stern, where it is terminated by the quarter-pieces. Although the lines by which the quarter and bow of a ship are determined, with respect to her length, are only imaginary, yet experience appears sufficiently to have ascertained their limits; so that if we were to divide the ship's sides into five equal portions, the names of each space would be readily enough expressed. Thus the first, from the stern, would be the quarter; the second, abaft the midships; the third, the midships; the fourth, before the midships; and the fifth, the bow. Falconer.

QUARTER, *On the, in Sea Language*, may be defined an arc of the horizon, contained between the line prolonged from the ship's stern and any distant object, as land, ships, &c. Thus if the ship's keel lies on an east and west line, the stern being westward, any distant object, perceived in the north-west or south-west, is said to be on the larboard or starboard quarter.

QUARTER is also used for a canton, or division of a city; consisting of several ranges of buildings, &c. separated from some other quarter by a river, a great street, or by some other boundary.

Such are the twenty quarters of the city of Paris. Ancient Rome was divided several times, under its several augmentations, into quarters, which were called *regions*; as may be observed in the topographies of Aurelius Victor, Onuphrius Panvinius, Marillan, Pyrrho Ligorio, Boiffard, and other antiquaries.

In many cities there are commissaries of the quarter appointed to look to the policy of them. The prior of the Caporions accounts himself the chief and colonel of the fourteen regions, or quarters, of Rome. Muscarat, p. 134.

QUARTERS, *Franchise of*. See **FRANCHISE**.

QUARTER, in *War*, the place allotted to certain forces to live, lodge, and encamp upon, during a siege, or the like. See **CAMP**.

The general's quarter, called the head-quarters of an army, is that where the general lodges and encamps in person. They used to make lines of communication, to join the several quarters together.

QUARTERS at a Siege, are the encampments on the principal passes about a place; serving to stop the avenues, and to prevent relief and convoys.

QUARTER is also used for any lodgment made in the field, or campaign, out of a siege. Thus they say, the general has extended his quarters a good way; the enemy coming by, made him contract his quarters.

QUARTERS, *Intrenched*, denote a place fortified with a ditch and parapet, to secure a body of troops.

QUARTERS, *Winter*, the place allotted troops to pass the winter season in. Wherein these differ from garrisons, see **GARRISON**.

Winter quarters, when cold or moist, are productive of inflammatory disorders, particularly hard coughs, with inflammations of the pleura or lungs. See **BARRACKS**.

QUARTERS, *Winter*, are also used for the time the troops

continue in this lodgment; and for the advantage the captains make of it.

In Spain they have also summer quarters.

QUARTER of Assembly, is the place of rendezvous, where the troops are to meet and draw up, to march in a body.

QUARTERS of Refreshment, denote some well provided, fertile spot, to which troops, that have been much fatigued and harassed, are sent to recover their strength, or health; even during the season of the campaign.

There are also quarters assigned for the hucksters, and their equipage.

QUARTER also denotes the safety and good treatment promised to persons or troops that surrender, and lay down their arms. Thus we say, the enemy begged quarter.

The phrase took its rise from an agreement anciently made between the Dutch and Spaniards, that the ransom of an officer, or soldier, should be a quarter of his pay. Hence, to beg quarter was to offer a quarter of their pay for their safety; and to refuse quarter was not to accept of that composition for their ransom.

On an enemy's submitting, and delivering up his arms, the victor cannot with justice take away his life. In a battle, quarter is to be given to those who lay down their arms; and at a siege, a garrison offering to capitulate are never to be refused their lives. If sometimes, however, in the heat of action, the soldier refuses to give quarter, it is always contrary to the inclination of the officers, who eagerly interpose for saving the lives of such enemies as have laid down their arms. Nevertheless, there is one case, in which life may be denied to an enemy who surrenders, and also capitulation refused to a place. This is when the enemy has been guilty of some enormous breach of the law of nations, and particularly if it be at the same time a violation of the laws of war. This denial of quarter is no natural consequence of the war, but the punishment of his crime; a punishment which the injured party has a right to inflict: but that the punishment may be just, it must fall on the guilty. When the war is with a savage nation, which observes no rules, and never gives quarter, it may be chastised in the persons of any that are seized or taken, among the guilty; so that by this rigour they may be brought to conform to the laws of humanity. But wherever severity is not absolutely necessary, clemency is to be used. Corinth was utterly destroyed, for having violated the law of nations towards the Roman ambassadors. However, that severity has been censured by Cicero, and other great men. He who has even the most just cause to punish a sovereign as his enemy, will always incur the reproach of cruelty, if he should cause the punishment to fall on the innocent people. There are other methods of chastising the sovereign; as the depriving him of some of his rights, taking from him towns and provinces. The evil which a whole nation suffers is the participation inevitable to the members of a political society. The learned Vattel expresses his astonishment that, in a knowing age, it could be conceived that it is lawful to punish with death a governor who has defended his place to the last extremity; or who, in a weak place, has presumed to make a stand against a royal army. Yet, even in the 17th century, this notion was so common as to make an article in the law of war; and, at a later period, it is not wholly exploded. What a thought! to punish a brave man for having performed his duty. Very different were the principles of Alexander the Great, when he gave orders for sparing some Milesians, "on account of their courage and fidelity." It is in vain to object, that an obstinate defence, especially in a weak place, against a royal army, only causes a great effusion of blood to no purpose; for this defence may save the state, by delaying the enemy some days longer; and,

and, besides, courage supplies the want of fortifications. It is urged farther, that by threatening a commander with death, you may shorten the bloody siege, spare your troops, and gain a valuable opportunity. The answer is, says Vattel, that a brave man will despise your menace, or, provoked at such ignominious usage, will sell his life at a dear rate, make you pay for your injustice, and bury himself under the ruins of his fort. Besides, the menace of an unjust punishment is unjust in itself; it is an insult and an injury. But to execute it, would be barbarous and horrible; and if it is not to take effect, it must be allowed to be vain and ridiculous. Nevertheless, just and lawful means may be used for inducing a governor not obstinately to reduce himself to the last extremity; and this is at present done by all wise and humane generals. A governor is summoned to surrender, and in the progress of the siege an honourable and advantageous capitulation is offered him, with an intimation that if he stays too long, he will be admitted only to surrender as a prisoner of war, and at discretion: if he persists, and is at length forced to surrender at discretion, all the severity of the law of war may be used, both against him and his troops. But this right never extends so far as to deprive an enemy of life, who lays down his arms, unless he has been guilty of some proportionate crime towards the conqueror. See *CAPITULATION*, *PRISONERS of War*, and *REPRISALS*.

QUARTERS, in *Building*, those slight, upright pieces of timber, placed between the punchions and posts; used to lath upon. They are of two kinds, single and double. The single quarters are sawn to two inches thick, and four inches broad; the double are four inches square.

QUARTERS in a clock, are little bells, which sound the quarters of an hour.

QUARTERS, in *Sea Language*, the several stations of a ship's crew in the time of action. See *QUARTERING the Men*.

QUARTER, in the *Manege*, to work from quarter to quarter, is to ride a horse three times upon the first of the four lines of a square; then changing your hand, to ride him three times upon the second; and so to the third and fourth, always changing hands and observing the same order.

QUARTERS of a Saddle, the parts or pieces of leather, or stuff, which are made fast to the lower part of the sides, and which hang down below the saddle.

QUARTERS of a Horse, and other Animals, the four principal parts of the animals; the fore-quarters consist of the shoulders and the fore-legs; the hind-quarters, of the hips and the hind legs.

In the horse, the fore-quarters or shoulders should always fall in a neat manner backwards, where they join with the breast, and the hind-quarters be suitably long and well shaped towards the rump. Something of a similarity of shape should likewise prevail in the quarters of neat cattle, sheep, and swine, but they should be much more fleshy downwards as they approach the thigh and leg parts. See *LIVE-Stock*, *HORSE*, *SHEEP*, and *SWINE*.

QUARTERS of the Foot, in horses, are the sides of the coffin, comprehended between the toe and the heel on both sides; the inner quarters are those opposite to one another, facing from one foot to the other; those are always weaker than the outside quarters, which lie on the external sides of the coffin. A horse is said to have a *false* quarter, when the hoof has a kind of cleft occasioned by the casting the quarter and getting a new one, for then the horn becomes uneven, and also softer than the rest of the hoof; and the foot should be shod with some nicety. But if the cleft be

considerable, and take up a fourth of the hoof, the horse is worth little afterwards for any purpose.

QUARTER-Cast, among horses, is when for any disease in the coffin-bone or joint, one of the quarters of the hoof is cast off, and when thus cast, the reproduction of a new hoof or part takes place. It is a common occurrence among some horses.

QUARTER-Evil, among domestic animals of the neat cattle kinds, is an affection which sometimes takes place in the glands of the udders, and sometimes in different parts of the feet.

QUARTERS, in *Gardening*, the large divisions of garden grounds, or those parts of them which are situated between the different walks, at a distance from the small, narrow portions on the sides usually termed borders, and which form or constitute the principal spaces or compartments for the cultivation and growth of the various sorts of the more useful culinary vegetables which are raised in large quantities; such as peas, beans, cabbages, cauliflowers, broccoli, early potatoes, and many others.

It is necessary to have the quarters of garden grounds formed and laid out in such a manner as to favour the growth of early and late crops of the several different sorts, as much as possible; those for the former having a southern, or south-western exposure, and those for the latter, an eastern, or north-eastern aspect. By these means, early crops are, in some measure, rendered more forward and fine, and those of the more late kinds, in some degree, prevented from being injured or burnt up and destroyed by too full an exposure to the heat of the sun.

It is usual during the winter season to have the large quarters of garden grounds laid up in high ridges, in order to be exposed to the influence and effects of frost, by which the earth may be rendered more light and mellow, and be in a more fit state for sowing or planting in the spring months, on throwing them down and rendering them level for the purpose.

The large quarters of gardens should likewise be kept as free and open as possible, not being inclosed and choaked up, as is too frequently the case by planting fruit-trees and shrubs on their sides, either in the manner of espaliers or otherways, as by such means the growths of the plants are much promoted, and they are prevented from being drawn up in a weak manner. See *GARDEN*.

All forms of garden grounds are found, except that of the square, to derange the regularity of the quarters, and, of course, to render them highly troublesome in digging and cropping. Where they are very large they may be subdivided into suitable sizes, as one hundred feet in breadth, &c.; but their length does not signify, as it may be varied in different ways, as by rows of trees, bushes, or which, in many cases, are preferable, by trodden walks and the modes of cropping.

QUARTERS of a Garden, the several divisions into which it is formed for the purpose of cultivating the different kinds of vegetables, fruits, &c. Thus, there are parts or quarters destined to the growth of kitchen vegetables, fruit, and other trees, forcing, &c.

QUARTERS of a Field, or Farm, in *Agriculture*, are the particular parts of them, which are under, set apart, or intended for any sort of crops, or peculiar modes of cultivation and management. Farmers are frequently in the practice of dividing their lands or farms into different quarters or parts, according to the different sorts of husbandry which they are proper for, and the manner and succession in which the various kinds of crops are to be grown upon them, and the same is often the case with large fields; four, five, six, and more divisions or quarters, being common in such instances.

instances. This plan of proceeding is supposed to give ease, facility, and dispatch, to the work which is afterwards carried on, as well as to have several other advantages and conveniences. See FARM.

QUARTER-Bill, in *Sea Language*, a roll or list, containing the different stations, to which all the officers and crew of the ship are quartered, in the time of battle, and the names of all the persons appointed to those stations.

QUARTER-Bullet, a bullet quartered into four or eight parts.

QUARTER-Chord, in *Mining*, seven yards and a quarter, which the miner hath cross-ways of his vein on either side, for liberty to lay his earth, stones, and rubbish on, and to wash and dress up his ore.

QUARTERS, *Cloze*, in a *Ship*. See CLOSE-Quarters.

QUARTER-Cloths, are long pieces of painted canvas extended on the outside of the quarter-netting from the upper part of the gallery to the gang-way. They are generally decorated with martial instruments, or allegorical figures.

QUARTER-Day. See QUARTER.

QUARTER-Deck of a ship, is that aloft the steerage, reaching to the round-house; or that deck in ships of war which extends from the main-mast to the stern, next above the upper-deck.

QUARTER, Fat, in a *Ship*, denotes the same with *broad*. Thus, if the trussing in, or tuck of a ship's quarter under water be deep, they say, she hath a *fat* quarter.

QUARTER-Gallery, a sort of small balcony, with or without ballustrades, on the quarter of a ship; which generally communicates with the gallery on the stern, by means of a door passing from one to the other.

QUARTER-Guard. See GUARD.

QUARTER-Gunner, is an inferior officer under the direction of the gunner of a ship of war, whom he is to assist in every branch of his duty; as keeping the guns and their carriages in proper order, and duly furnished with whatever is necessary; filling the powder into cartridges; scaling the guns, and keeping them always in a condition ready for service. The number of quarter-gunners in any ship is always in proportion to the number of her artillery; one quarter-gunner being allowed to every four cannon.

QUARTER-Netting, is a sort of net-work, extended along the rails on the upper part of a ship's quarter. In a ship of war these are always double, being supported by iron cranes, placed at proper distances. The interval is sometimes filled with cork or old sails, but chiefly with the hammocks of the sailors, so as to form a parapet to prevent the execution of the enemy's small arms in an engagement.

QUARTER-Pieces, substantial pieces of timber, mostly of fir, that form the outboundary of the stern, and connect the quarter-gallery to the stern and toffarel.

QUARTER-Point of the Compass. See POINT.

QUARTER-Rails, in a *Ship*, are narrow-moulded planks, generally of fir, reaching from the top of the stern to the gang-way. They are supported by stanchions, and serve as a fence to the quarter-deck, to prevent the men from tumbling into the sea by the rolling of the ship, particularly in small vessels.

QUARTER-Round, in *Architecture*, is a term used by the workmen for any projecting moulding in general, whose contour is a perfect quadrant, or quarter of a circle, or which approaches near that figure.

The architects usually call it *ovolo*; and Vitruvius, the *echinus*.

QUARTER-Sessions, *General*, *Court of*. See COURT of *General Quarter-Sessions*, and *SESSIONS*.

QUARTER-Staff, a long staff, or pole, borne by foresters,

park-keepers, &c. as a badge of their office; and occasionally used as a weapon.

QUARTER-Wheeling, or *Quarter of Conversion*, in the *Military Art*, is the motion by which the front of a body of men is turned round to where the flank was; this making the quarter of a circle.

If it be done to the right, the man in the right-hand angle keeps his ground, and faces about, while the rest wheel; if to the left, the left-hand man keeps his place, &c.

QUARTER-Wind, at *Sea*, is a lateral, or side-wind; or a wind which does not blow in stern, but a little aside of it.

Properly, the quarter-wind is that which comes in abaft the main-mast shrouds, even with the quarter of the ship.

The quarter-wind is the best of all winds, as bearing into all the sails; whereas a wind blowing full in stern, is kept off by the sails of the mizen.

QUARTERA, in *Commerce*, a corn-measure in Spain, containing 12 cortanes: the palma contains 4 quarteras, or 48 cortanes; the carga, $2\frac{1}{2}$ quarteras, or 30 cortanes: $78\frac{1}{4}$ quarteras correspond to 100 Castilian fanegas; and 100 quarteras Catalan to 128 Castilian fanegas; 39 quarteras Catalan contain 10 English quarters. The carga of wine and brandy is divided into 16 cortanes, 32 quarteras, or 128 quartillos.

At Barcelona 39.08 quarteras are equal to 10 English quarters, and a single quartera contains 4401 cubic inches. Kelly's Un. Cambist.

QUARTERED, *COUNTER*. See COUNTER-QUARTERED.

QUARTERIDGE, money paid quarterly, or by the quarter.

QUARTERING of Soldiers, in *Military Language*, seems to have anciently differed very little from that now in use, except that they were indiscriminately quartered upon all householders, as was practised in England so late as in the rebellion of the year 1745. Rapin says, that William the Conqueror quartered almost all his troops upon the monasteries, and obliged the monks to furnish them with necessaries; by which means he maintained his army without any charge, and had spies in all their religious houses, who watched the actions of the monks; these houses were long after charged with finding carts and horses for the carrying the baggage of the army; and there are still extant many of the original returns from different monasteries, stating the number of each they were able to furnish for that purpose. About the time of Henry VII. we meet with a regulation that bears some reference to quarters: this is a coat and conduct-money; the first was a species of cloathing, probably for recruits; the money for which was advanced by the county in which they were raised;—conduct-money was an allowance for subsistence, to and from the army, according to the number of days which the soldiers had to march; a day's march being estimated sometimes at 12 and sometimes at 15 miles. Both the coat and conduct-money were occasionally advanced by the different counties in which the troops were quartered, under the promise of being repaid by government. Towards the latter end of the reign of king James II. and even after the accession of king William III. soldiers used to oblige the inhabitants of the towns in which they were quartered, not only to furnish them with diet and lodging, but also to advance them their daily subsistence. After the revolution, by the mutiny-act, passed the 23d day of December, in the year 1689, other laws and regulations respecting quarters were enacted.

By the petition of right in the third of Charles I. it is enacted and declared, that the people of the land are not by the laws to be burthened with the sojourning

of soldiers against their wills; it is also enacted by the 31 Car. II. c. 1. that no officer, military or civil, nor any other person whatsoever, shall presume to place, quarter, or billet any soldier on any subject or inhabitant of this realm, of any degree, quality, or profession whatsoever, without his consent; and every such subject or inhabitant may refuse to sojourn or quarter any soldier, notwithstanding any command, order, warrant, or billeting whatever. The present mode of quartering our troops is settled by the Mutiny Act, renewed annually, with little or no alteration. Accordingly by the mutiny act, 49 Geo. III. c. 12. s. 41. the constables and other chief officers and magistrates of cities, towns, villages, and other places, and in their default or absence, any one justice inhabiting in or near such place, and no other, shall and may, during the continuance of this act, quarter and billet officers and soldiers in inns, livery stables, alehouses, victualling houses, and the houses of sellers of wine by retail to be drank in their own houses or places thereunto belonging, (other than person's canteens held under the authority of the commissioners for the affairs of barracks, and other than persons who keep taverns only, being free of the vintners' company in London,) and all houses of persons selling brandy, strong waters, cyder, or metheglin, by retail to be drank in houses, (other than the houses of distillers who keep places of distilling brandy and strong waters, and of shopkeepers whose principal dealings shall be more in other goods than in brandy and strong waters, and who do not permit tipling in their houses,) and no other, and in no private houses whatsoever; nor shall any more billets be ordered than there are effective soldiers; which billets when made out shall be delivered to the commanding officer present: and if any constable, or such like officer or magistrate as aforesaid, shall presume to billet any such officer or soldier in any private house without the consent of the owner or occupier, such owner or occupier shall have his remedy at law against such magistrate or officer, for damages; and if any military officer shall take upon him to quarter soldiers otherwise than by this act, or shall offer any menace or compulsion to any mayor, or other civil officer before-mentioned, tending to discourage any of them from doing their duty, he shall on conviction before any two justices by the oath of two witnesses be *ipso facto* cashiered and disabled to hold any military employment; provided the conviction be affirmed at the next quarter sessions, and a certificate thereof be transmitted to the judge advocate, who shall certify the same to the next court martial. And if any person shall be aggrieved by having more soldiers billeted than in proportion to his neighbours, on complaint thereof to one justice of the division, &c. where quartered, or if the person so billeting them be a justice, then on complaint to two justices they may relieve him.

Note.—The clause above recited, relating to shopkeepers, might as well be now omitted out of the act; for that by the 17 Geo. II. c. 17. no shopkeepers, as such, are allowed to retail any spirituous liquors, but only those who keep taverns, victualling houses, inns, coffee-houses, or ale-houses.

By s. 43. No justice, having any military command, shall be concerned in quartering soldiers under his immediate command; but all things done by him therein shall be void.

By s. 50. of this act, an officer taking money for executing the quartering, shall be cashiered.

By s. 51. If any high constable or other officer or any person whatsoever shall neglect to quarter any officers or soldiers, provided sufficient notice be given him before their arrival, or if he receive or agree for any reward in order to

excuse any person from receiving such officer or soldier, or if any victualler, &c. having any officer, &c. billeted upon him, refuse to receive him, or refuse to furnish him as herein provided by this act, and shall be thereof convicted by one justice of the county, &c. where such offence was committed, on confession of the oath of one witness, he shall forfeit not more than 5*l.* nor less than 40*s.* to be levied by distress; which sum shall be applied first to satisfy such soldier for the expence thereby occasioned to him, and the remainder to the overseers of the poor of the parish where the offence was committed.

By s. 56. If any officer, military or civil, shall quarter any of the wives, children, or servants of officer or soldier, in any house, against the consent of the owner; if he be an officer, he shall on proof made thereof to the commander in chief of the army or judge advocate, be *ipso facto* cashiered; and if a civil officer, he shall forfeit to the party grieved 20*s.* on proof thereof to the next justice by distress.

By s. 53. Officers and soldiers, billeted as aforesaid, shall be received and furnished with diet and small beer, paying for the same as hereafter mentioned, out of their subsistence-money.

By s. 54. If any person shall choose rather to furnish non-commissioned officers or private men, with candles, vinegar, and salt, *gratis*, and allow them the use of fire and the necessary utensils for dressing and eating their meat, and shall give notice thereof to the commanding officer, and shall furnish the same accordingly; in such case they shall provide their own victuals and small beer, and the officer who receives their pay shall pay the sums after mentioned out of the subsistence-money for diet and small beer to them, and not to the persons on whom they are quartered.

By s. 55. Every officer receiving the pay or subsistence-money, either for a regiment, or particular troops and companies, or otherwise, shall immediately, upon each receipt of each sum, give public notice thereof to all on whom officers or soldiers are quartered; and shall also appoint such persons to repair to their quarters, at such times as they shall appoint, for the payment of the said pay or subsistence-money to the officers or soldiers, which shall be within four days at the farthest after the receipt of the same, as aforesaid; and such persons shall then and there acquaint such officer with the accounts or debts between them and the officers and soldiers quartered; which accounts the said officer is to accept of, and immediately pay the same, before any part of the pay or subsistence be distributed: provided the said accounts exceed not, for a commission officer of horse being under the degree of a captain, for such officer's diet and small beer, *per diem*, 2*s.*; nor for one commission officer of dragoons, being under the degree of a captain, for such officer's diet and small beer, *per diem*, 1*s.*; nor for one commission officer of foot, under the degree of a captain, for such officer's diet and small beer, *per diem*, 1*s.*; nor for each horse quartered under this act, for hay and straw, *per diem*, 6*d.*; nor for one light horseman's diet and small beer, *per diem*, 7*d.*; and hay and straw for his horse, *per diem*, 6*d.*; nor for one dragoon's diet and small beer, *per diem*, 7*d.*; and hay and straw for his horse, *per diem*, 6*d.*; nor for one foot soldier's diet and small beer, *per diem*, 5*d.*: and if such officer shall not so give notice and shall not immediately upon producing such account stated satisfy the same; upon complaint on oath by two witnesses, at the next quarter sessions for the county or city where such quarters were, the paymaster of the guards, garrisons, and marines, are authorized (upon certificate of the said justices before whom such oath was made, of the sum due upon such accounts and the persons

sons to whom the same is owing) to pay the said sums out of the arrears due to the said officer, upon pain of such paymaster forfeiting his place, and being incapacitated from holding it again. The act then states what course is to be pursued if there be no arrears due, or no subsistence-money remitted, and is directory of the course to be pursued by the paymaster.

By f. 49. The commanding officer may exchange any men or horses quartered in any place with another man or horse quartered in the same place, provided the number of men and horses do not exceed the number at that time billeted on such house.

By f. 47. And where any horse or dragoon shall be quartered upon any person who hath no stables, upon his complaint to two justices of the division, &c. and his making such allowance as such justices shall think reasonable, they may order the men and their horses, or the horses only, as the case may be, to be removed and quartered upon some other person who hath stables, and may order and settle a proper allowance to be made by the person having no stables, in lieu of his quartering such horse or dragoons, and order payment thereof to the person to whom the removal is made, for or to be applied for the furnishing of quarters for such men and their horses.

By 49 Geo. III. c. 37. It is enacted that every non-commissioned officer and private soldier who shall be furnished with diet and small beer by the persons on whom they are quartered, shall pay for the same 1s. 4d. *per* day, in like manner as by the first act is enacted as to the 7d. *per* day.

By f. 2. Where the innholder, &c. furnishes certain articles in lieu of diet and small beer, as in the former act mentioned, he shall have one halfpenny *per* day for each non-commissioned officer, &c.

By f. 3. 1s. 3d. *per* day is to be paid for each horse, instead of 6d. *per* day.

By f. 4. The provisions in the former act relating to the dieting on a march or recruiting are repealed.

By f. 5. All non-commissioned officers and soldiers shall receive their diet and small beer at the above rates while on the march and on the day of arrival at the place of their final destination, and on the two subsequent days, unless either of the two be a market day for the place where billeted, or within two miles thereof; in which case the innkeeper, &c. shall discontinue on and from such market-day the diet and small beer, and furnish in lieu thereof the articles in the said former act specified, and at the rate in this act prescribed.

By f. 6. If any person liable to have soldiers quartered on him shall pay any sum to any non-commissioned officer or soldier on the march in lieu of the diet and small beer, he may be proceeded against and fined as if he had refused to furnish according to the former act the things to be furnished to non-commissioned officers and soldiers so quartered as aforesaid.

By f. 7. The provisions of f. 5. are extended to halting on a march.

By f. 8. But if the halt be for longer than one day, and the day after the arrival be market-day as aforesaid, there is to be no discontinuance of diet and small beer.

By f. 9. Non-commissioned officers and private men employed in recruiting, and the recruits by them raised, shall, while on the march, and for two days after the day of their arrival at any recruiting station, be entitled to the same benefits as before provided for troops on the march; but no recruit enlisted after the two days subsequent to the arrival of the party at their recruiting station, shall be entitled to be supplied with diet and small beer at the rate herein-before

prescribed, except at the option of the party where quartered. Provided that in case any recruiting party, with the recruits by them raised, shall remove from their station, and after a time shall return to the same place, they and the recruits shall not be again entitled to the diet and small beer for two days, unless the time of absence exceeded 20 days. This act to continue to 25th March 1810.

By f. 52. Any justice within his county, &c. may command any constable or other officer who shall billet any soldiers, to give an account in writing to him of the number of officers and soldiers billeted by them, and the names of the persons on whom quartered, and an account of the place where they dwell, and of their signs, if any. See *MARTIAL LAW*, and *SOLDIERS*.

But by the 50 G. III. c. 96. f. 1. it is enacted, that after the 25th of June 1810, every non-commissioned officer and private soldier who shall be furnished with diet and small beer within the parts of the united kingdom mentioned in the 50 G. III. c. 28. by the innholders or other persons on whom such non-commissioned officers or private soldiers shall be quartered and billeted by virtue of the said act, shall pay and allow for the same, the sum of eight-pence *per diem* instead of one shilling and four-pence *per diem*, as in the said act specified; and that for such allowance of eight-pence, the innkeeper or other person shall furnish one meal; *videlicet*, a hot dinner if required in each day to each non-commissioned officer, trumpeter, drummer, and private soldier quartered and billeted on him, to consist of such quantities of diet and small beer as shall be specified and fixed in and by any regulations made or to be made from time to time by his majesty in that behalf, but not to exceed one pound and a quarter of meat previous to being dressed, one pound of bread, one pound of potatoes or other vegetables previous to being cooked, and two pints of small beer, and vinegar, salt, and pepper.

And by f. 2. of the same act, the mutiny act, and the said 50 G. III. c. 28. shall be applied for the enforcing such regulations as to the diet of soldiers and the payment of and accounting for the allowances for the same.

QUARTERING of Traitors, in Law. See *TREASON*.

QUARTERING, in the Sea Language. When a ship under sail goes at large, neither by a wind nor before a wind, but, as it were, betwixt both, she is said to go quartering.

The term is also used when a ship sails with quarter-winds.

QUARTERING the Men, the disposing of the ship's company at the time of an engagement in such a manner, that each may readily know where his station is, and what he is to do: as, some to the master, for the management of the sails; some to assist the gunners to traverse the ordnance; some for plying the enemy with small shot; some to fill powder in the powder-room; others to carry it from thence to the gunners in cartridges, &c.

The number of men appointed to manage the artillery is always in proportion to the nature of the guns, and the number and condition of the ship's crew. They are in general as follow, when the ship is well manned, so as to fight both sides at once occasionally:

To a 42-pounder	-	15 men.
32.	-	13
24	-	11
18	-	9
12	-	7
9	-	6
6	-	5
4	-	4
3	-	3

This number, to which is often added a boy to bring powder to every gun, may be occasionally reduced, and the guns nevertheless well managed.

The number of men appointed to the small arms, on board his majesty's ships and sloops of war by order of the admiralty, are,

Rate of the Ship.	Number of Men.
1st - -	150
2d - -	120
3d of 80 guns -	100
— of 70 guns -	80
4th of 60 guns -	70
— of 50 guns -	60
5th - -	50
6th - -	40
sloops of war -	30

The lieutenants are usually stationed to command the different batteries, and direct their efforts against the enemy. The master superintends the movements of the ship, and whatever relates to the sails. The boatwain and a sufficient number of men are stationed to repair the damaged rigging: and the gunner and carpenter whatever may be found necessary, according to their respective offices. The marines are generally quartered on the poop and forecabin, or gangway, under the direction of their officers: although, on some occasions, they assist at the great guns, particularly in distant cannonading. Falconer. See ENGAGEMENT.

QUARTERING, in *Gunnery*, is when a piece of ordnance is so traversed, that it will shoot on the same line, or on the same point of the compass, as the ship's quarter bears.

QUARTERING, in *Heraldry*, the act of dividing a coat into four or more quarters, or quarterings, by parting, coupling, &c. *i. e.* by perpendicular and horizontal lines, &c. See QUARTER and QUARTERLY.

The king of Great Britain quarters with Great Britain, France, Ireland, Brunswick, &c.

Colombiere reckons twelve forts of quartering; but other authors give us more—*viz.* party per pale, dividing the escutcheons from top to bottom. See PALE.—Party per cross, dividing it from side to side. See CROSS.—Party of six pieces, when the escutcheon is divided into six parts, or quarters.—Party of ten; of twelve; of sixteen; of twenty; and of thirty-two; when there are so many partitions respectively.

Others give the divisions in another manner: as—Party per cross—per pale—per chief—per pale inclave—per bend dexter—per bend sinister—per chevron—barry bendy of eighty pieces—paleways of six pieces—barry of six pieces—barry of eight pieces—bendy of six—checky—fussilly, or lozengy—pale bendy, or bendy lozengy—barry bendy lozengy, or bend lozengy—gyronny—barry lozengy counter-changed—waved of six pieces—barry nebule of six pieces—party per saltier—and party per pale in point. See farther under their respective articles.

Counter-quartering a coat, is when the quarters are quartered over again, or subdivided each into four. See COUNTER-QUARTERED.

There are counter-quartered coats which have twenty or twenty-five quarters.

QUARTERING is also applied to the partitions or compartments themselves, that is, the several coats borne on an escutcheon, or the several divisions made in it, when the arms of several families are to be placed on the same shield, on account of intermarriages, or the like.

Colombiere observes, that thirty-two is the greatest number

used in France; but that the English and Germans sometimes extend to forty: as a testimony of the truth of which, he says he saw the escutcheon of the earl of Leicester, ambassador extraordinary in France in the year 1639, divided into the number of forty: and some, he affirms, do go on to sixty-four several coats.

But a multitude of quarters make a confusion; and, accordingly, all the writers of armoury exclaim against it as an abuse. The first instance of quartering, of which we have any account, is said to be in the arms of Renatus, king of Sicily, &c. in the year 1435, who quartered the arms of Sicily, Arragon, Jerusalem, &c.

William Wicly observes, that such quarterings are much more proper for a pedigree, to be locked up in a chest, and occasionally produced as an evidence for the clearing or ascertaining of alliances of families, and titles to lands, &c. than to be borne as a cognizance.

In blazoning, when the quartering is performed per cross, the two quarters a-top are numbered the first and second: and those at the bottom the third and fourth; beginning to tell on the right side. When the quartering is by a saltier, &c. the chief and point are the first and second quarters, the right side the third, the left the fourth.

QUARTERING is sometimes also used for the distinguishing of younger brothers from elder. See DIFFERENCE.

QUARTERIZATION, QUARTERING, part of the punishment of a traitor, by dividing his body into four quarters.

“Walsingham, in Ric. II. Auditum et confessum turpissima scelera tractationi, fuspensio, decollationi, exenterationi, et quarterizationi adjudicavit.”

QUARTERLY, in *Heraldry*, a person is said to bear quarterly, when he bears arms quartered.

The king of Great Britain bears quarterly of four; in the first quarter gules, &c. Great Britain; in the second, azure, &c. Ireland, &c.

QUARTER-MASTER, an officer in the army, whose business it is to look after the quarters of the soldiers; their clothing, bread, ammunition, firing, &c. Every regiment of foot and artillery has a quarter-master, and every troop of horse one, who are only warrant-officers, except in the blues. Whereof there are several kinds; *viz.* the

QUARTER-MASTER *General*, whose business is to provide good quarters for the whole army.

QUARTER-MASTER *of Foot*, he who is to provide quarters for a regiment of foot.

QUARTER-MASTER *of Horse*, he who is to provide quarters for a troop of horse.

QUARTER-MASTER, in a *Ship*, is an inferior officer, appointed by the master of a ship of war to assist the mates in their several duties; as stowing the ballast and provisions in the hold, coiling the cables on their platforms, overlooking the steerage of the ship, and keeping the time by the watch-glasses.

QUARTERN, QUARTERON, a diminutive of quart, signifying a quarter of a pint, as a quart does a quarter of a gallon.

QUARTIER, in *Commerce*, a liquid measure in Germany, which, according to a regulation of 1713, made in Hanover, must hold 2lb. of spring water, and the contents of which are 49 French, or 59½ English cubic inches. A fuder of wine contains 4 exhofts, 6 ahms, or 15 eimers; an alm, 4 ankers, 40 stubgens, 80 kannes, 160 quartiers, or 320 nassels. Hence 36 stubgens, or 144 quartiers, = 37 English wine gallons. A fass of beer at Lubec contains 42 stubgens, or 168 quartiers. Kelly's Un. Cambist.

QUARTILE, an aspect of the planets when they are three signs, or 90 degrees distant from each other.

The quartile aspect is marked thus □. See ASPECT.

QUARTILLO, in *Commerce*, a liquid measure in Spain. At Barcelona, 128 quartillos are equal to 32 quarteras. (See **QUARTERA**.) A moyo of wine contains 16 arrobas; an arroba 8 azumbres, or 2 quartillos. The arroba of wine contains 34lb. of river water (Castilian weight), and measures 1237½ Spanish, or 981 English cubic inches; hence four such arrobas are equal to 17 English wine gallons. The arroba of oil measures 966½ Spanish, or 771 English cubic inches; so that three such arrobas correspond to 10 English gallons: this arroba is divided into 4 quartillos, or 100 quarterones, or panillas. A Spanish botta contains 30 arrobas of wine, or 38½ of oil; a pipe is 27 arrobas of wine, or 34½ of oil; thus the botta is = 127½ English gallons, and the pipe = 114¾. Kelly. See *Tab. XXXII. of MEASURES*.

QUARTO, or 4to. a book whereof four leaves, or eight pages, make a sheet.

QUARTO, in *Commerce*, a money of account in Spain. See **REAL**.

QUARTO Dell Torri, in *Geography*, a town of Naples, in Capitanata; 12 miles W. of Salpe.

QUARTO die post, in *Law*, denotes the fourth day inclusive beyond the return of a writ, in which those that are summoned are allowed to make their appearance. See *Essoign day of term*.

QUARTO-DECIMANS, **QUARTO-DECIMANI**, in *Ecclesiastical History*, an ancient sect in the church, who maintained, that Easter was always to be celebrated, conformably to the custom of the Jews, on the fourteenth day of the moon in the month of March, whensoever that day fell out.

And hence their name Quarto-decimani, *q. d.* Fourteenthers.

The Arians were mightily attached to this opinion, pretending that it was built on the authority of St. John, who was their apostle; and pope Victor could never bring them to obedience in this article, though he was upon the point of excommunicating them: but it is more probable he contented himself with menaces. See **EASTER**.

QUARTUM par contringens, in *Anatomy*, a name given by Spigelius and some others to the muscle called by Albinus and Riolanus orbicularis oris; and by Cowper and some others, *constrictor labiorum*.

QUARTUS hyoidis musculus, a name given by Vesalius, Fabricius, and many other anatomists, to a muscle now generally called the *coracohyoidæus*.

QUARTUS oculum movens, a name given by Vesalius to one of the muscles of the eye, called by some *rectus inferior*, and by others *humilis*.

It is the *depressor oculi* of Albinus, being one of the *quatuor recti oculi* of that author.

QUARTZ, in *Mineralogy*. No substance in the mineral kingdom is more abundantly distributed than quartz. Grains of quartz generally compose a considerable part of the sands on the sea-shore, and of the sand-stones of the secondary strata. Rolled pieces of quartz, or pebbles and boulders, are widely scattered over alluvial districts. Quartz is disseminated through granite, gneiss, mica-slate, and other compound rocks which constitute the loftiest mountains on the globe; it also forms veins of vast extent intersecting these mountains, and sometimes entire simple rocks are composed of this mineral. Quartz has a considerable degree of hardness, always striking fire with steel when the fragments have sufficient solidity to resist the shock. Powdered quartz feels harsh, and, when rubbed on polished steel, or on glass, scratches the surface. Quartz is insoluble by the common blowpipe. These two qualities, hardness and insolubility, are the essential characters of all the varieties of quartz,

whatever forms or colours they may present, whether massive or crystallized.

Quartz has most commonly a conchoidal fracture, but sometimes the fracture is undulated, foliated, or splintery. The lustre is vitreous. Quartz has various degrees of transparency; from a perfectly pellucid colourless state, it passes by different gradations to opacity: but all the varieties, except sinople, admit light through the very minute fragments. The colours are various, owing to the impregnation or intermixture with foreign substances. The specific gravity of quartz is from 2.58 to 2.65. It yields a phosphorescent light when rubbed, and is not soluble in any of the acids except the fluoric. According to Vauquelin, powdered quartz gives a green colour to tincture of violets. Crystallized quartz presents the phenomenon of double refraction, when an object is seen through one side of the pyramid that terminates the crystals, and the opposite side of the hexagonal prism on which it is placed, in the most common variety of the secondary forms of these crystals.

The substances found imbedded in quartz are, ores of titanium, antimony, gold, silver, copper, and lead, arsenic, and micaceous iron ore, with chlorite, hornblende, feldspar, garnet, and fluat of lime. It is also penetrated by fibres of asbestos, and by minute laminae of mica and epidote: the latter substance is sometimes so intimately diffused through quartz as to give it an homogeneous green colour. This variety of quartz is called *prase*.

Quartz crystallizes distinctly: some of the crystals are of considerable size.

In the imperial cabinet of Vienna, there is said to be a crystal of quartz seven feet in length. The forms of crystalline quartz are various; they have been reduced by modern mineralogists to six or seven principal varieties. The most common is a six-sided prism, terminated by a six-sided pyramid, or two six-sided pyramids joined at their bases. The sides of these pyramids are isosceles triangles, having the vertical angle 40°, and each of the angles at the base 70°. The sides of the upper and lower pyramids are inclined to each other at an angle of 104°. According to Haüy, the primitive form of the crystal is a rhomboid, varying little from the cube, the angles being 94° and 86°. The primitive rhomboid is rarely found in nature; it occurs sometimes in red hematite, coated with that mineral, and in chalcidony.

Bubbles containing air, water, and bitumen, are sometimes seen in quartz crystals, and have given rise to much speculation respecting their formation. Siliceous earth, of which these crystals are composed, is insoluble in water, by artificial means; but in the great laboratory of nature, its solution is effected probably by the effect of heat and compression, as silex exists in the boiling fountains of Iceland and the Azores, and in the hot springs of Bath, Italy, and various parts of the world. It has been supposed that the siliceous earth was held in solution by soda; but Klaproth, who analysed the waters from the Reikun, in Iceland, thinks the quantity of alkali too small to have dissolved the silex. One hundred cubic inches contained nine grains of silex, three of carbonate of soda, eight of common salt, and five of sulphate of soda. If rock crystals were formed in an aqueous solution greatly heated and compressed, it would not be difficult to conceive how volatile matter might be involved in the substance of the crystal during its formation; but our knowledge of the subterranean operations of nature is at present too limited to enable us to ascertain, or even to form any rational conjecture in what manner some of her more mysterious processes are effected. Those who have frequent opportunities of exploring mines, will not be disposed to deny that siliceous stalaclites, and crystals, are now forming at the common temperature of the earth, as they are observed

QUARTZ.

served on the roofs and sides of artificial excavations, and passages which have been undisturbed for some years. According to Chaptal, a quartzose or a siliceous paste is formed by transudation on ferruginous rocks at Chamillat, near Planches les Mines, in Franche Comté, and where this is washed and deposited by water, rock crystals are formed. Siliceous stalactites have not unfrequently been seen coating the wood which has been left in mines.

Pseudomorphous crystals of quartz, or false crystals of this mineral, are frequently found in mines; they are tarnished and opaque, and their edges are blunted. They assume the forms of cubic crystals of fluor, and the pyramidal and other forms of calcareous and other crystals. These false crystals are evidently moulded in the cavities which the former have once occupied. Quartz also occurs filling up the cavities of shells in a similar manner, and the pores of wood and other organic substances.

Cellular quartz with polyhedral cavities, appears to have been formed round crystals of other minerals which are subsequently decomposed. The internal crystals are frequently those of the metallic sulphurets. Brongniart says this conclusion is founded on direct observation, as the remains found in these cavities are sulphur, native gold, and oxyd of iron, all substances which originally formed part of the decomposed sulphurets. Such is the cellular quartz at Schemnitz in Hungary, and Joachimsthal in Bohemia. The cellular quartz at Berezoj, in Siberia, is so porous that it is lighter than pumice.

Rock crystal, or Mountain crystal, is the purest variety of quartz, differing from common quartz by its transparency, and the more regular form of its crystals; the fracture is also more perfectly conchoidal. According to some analyses, rock crystal contains 98 parts of silice, with 2 parts of water. Bergman found in one specimen only

Silice	-	93
Alumine		6
Lime	-	1

Amethyst is a purple variety of rock crystal. See AMETHYST.

Cairngorum stones are rock crystals, from the mountains of Cairngorum, in Scotland. They are valued by jewellers on account of their purity and colour. Clove-brown quartz crystals are known by the name of the smoke topaz. According to Karsten, the specific gravity of this variety is 2.88. Coloured rock crystals lose their colour, when carefully exposed to a gentle heat, but retain their transparency. The yellow and orange-yellow varieties are the most esteemed.

Milk quartz, called by some mineralogists rose quartz, and by others the Bohemian ruby, as it is frequently of a beautiful rose-red colour, which it derives from manganese. By exposure to the light the intensity of its colour is diminished. It is used in jewellery, and takes a good polish; it is sometimes sold for the ruby, but is less hard, nor has it the transparency and brilliancy of that gem. Rose quartz is found at Rabenstein, in Bavaria, in considerable masses, and in a vein of manganese which traverses a coarse-grained granite. It occurs also in Sweden, Greenland, Saxony, in the island of Coll, one of the Hebrides, and in Ireland. Some varieties are of a milk-white colour, others pearl-grey.

Iridescent quartz, Quarz hyalin irisé, presents on its surface, or in its interior, the various colours of the rainbow: it sometimes derives this property from a thin pellicle of metallic oxyd which covers the surface, and sometimes from minute fissures in the substance of the crystal. These colours may be given to quartz by heating it and exposing it suddenly to a cold temperature.

Avanturine quartz (see AVANTURINE) owes its brilliancy to minute particles of mica disseminated through it, and sometimes to minute fractures. Avanturines may be formed artificially, in some varieties of quartz, by heat.

Blue quartz, Quarz hyalin saphain, has been found in Spain, Bohemia, and Bavaria.

Black quartz is found, mixed with carbonate of lime, in the department of Here in France, in Bohemia, and at Cappe Nuova, on the road to Sienna. Brongniart Mineralogie.

Cat's-eye, Quarz hyalin chatoyant, so called because it reflects a pearly variety of colours, according as the light falls upon it in different directions: this property is owing to the fibrous texture of this mineral, which may be observed in the best characterized specimens. It contains 95 parts of silice, and according to Brongniart is a variety of quartz, and ought not to be classed with felspar. The geological situation of this stone is not known. The cut and polished specimens seen in cabinets come from Malabar and Ceylon. It is said, also, to occur in Egypt and Arabia.

Green quartz, Prasé, Quarz hyalin verd obscur. The colour is a leek green; it is seldom crystallized; the form of the crystals are those of common quartz. Prasé has been said to owe its colour to an intimate intermixture with actynolite, but Klaproth is of opinion that this is not well ascertained.

Sinople is classed, by some mineralogists, with quartz. It is of a deep blood-red colour, and perfectly opaque, or barely transmits light on the edges. It resembles red jasper, but has a vitreous lustre, and conchoidal fracture, and is sometimes crystallized.

Ferruginous quartz consists of small crystals, or of granular quartz, intimately mixed with oxyd of iron, and has a brown ochre-yellow, or red colour. From the iron which it contains it becomes magnetic when heated. It is harder than pure quartz.

Certain properties, beside colour, have given names to some varieties of quartz.

Fat quartz is so called because it has a greasy appearance, as if the surface had been rubbed with oil.

Fetid quartz differs from common quartz, by emitting an odour, when rubbed, like that of sulphuretted hydrogen gas. When this fossil is heated below a red heat, it loses its fetid odour on cooling, and when plunged into water becomes transparent. When fetid it is nearly opaque. It is found in the vicinity of Nantes and Chantiloub, in the department of Haute Vienne, forming a constituent part of the granitic mountains of that district. It occurs also in the island of Elba.

Elastic quartz is a siliceous sand-stone, found in the Brazils, composed of oblong laminae of quartz, arranged in one direction, and so interlocked together as to form a kind of hinge with each other, from whence it possesses a certain degree of pliability, like that of a stiff piece of leather. In appearance, elastic quartz resembles some of the slaty sandstones in the northern counties of England. According to Klaproth its constituent parts are

Silice	-	-	96.50
Alumine	-	-	2.50
Oxyd of iron and loss			1

The use of quartz in the arts is principally confined to the manufactures of glass, enamels, porcelain, and earthenware. The finer crystallizations are employed by the jewellers, and before the discovery of glass, ornaments and vessels of great value were made by the ancients from rock crystal. Stones in which quartz forms the principal ingredient, are best fitted for purposes of durable architecture, and in the economy

economy of nature this mineral gives stability to the solid fabric of the globe, enabling those rocks and mountains in which it abounds to resist the decomposing effects of air and moisture, and to brave for ages the impetuous fury of the ocean. For the properties of flint, of which quartz is composed, see *SILEX*.

QUARTZ Rock, in *Geology*. Entire rocks and even mountains are composed of quartz in various parts of the world, in the vicinity of granitic districts. The quartz is granular, and sometimes intermixed with a small portion of mica. Werner classes quartz rock as a distinct order of primary rocks, but it would be perhaps more consonant with a natural arrangement, to consider this rock as a constituent of granite on a large scale, certain causes having separated the quartz, mica, and felspar into distinct masses. Entire mountains of these three substances are said to occur in the Uralian chain, presenting the materials of granite on a large scale. Quartz rocks are met with in Scotland. In the highlands the summits of some of the mountains are formed of white quartz, and appear as if covered with snow. The two beautiful conical mountains, called the *Sugar-loafs*, in the vicinity of Dublin, are composed of granular quartz, of a similar kind to what forms veins in the gneiss and mica slate of the surrounding mountains nearer Dublin.

QUARTZOSE, in *Mineralogy*, a term applied to those rocks or minerals which are principally composed of quartz.

QUASHING, in *Law*, the overthrowing and annulling a thing. Thus, pleas in *abatement* (which see), when the suit is by original, conclude to the writ or declaration; by praying "judgment of the writ, or declaration, and that the same may be quashed," *causetur*, made void or abated; but if the action be by bill, the plea must pray "judgment of the bill," and not of the declaration; the bill being here the original, and the declaration only a copy of the bill. See *PLEA*, *DILATORY Pleas*, and *CERTIORARI*.

QUASI-CONTRACT, in the *Civil Law*, an act which has not the strict form of a contract, but yet has the force of it.

In a contract there must be the mutual consent of both parties; whereas, in a quasi-contract, one party may be bound or obligated to the other, without having given his consent to the act by which he is obliged.

For an example: I have done your business in your absence, without your procuration; and it has succeeded to your advantage; I have then an action against you for the recovery of what I have disbursed; and you an action against me, to make me give an account of my administration; which amounts to a quasi-contract. See *CONTRACT*.

QUASI-CRIME, or **QUASI-DELICT**, the action of a person who does damage, or evil, involuntarily.

The reparation of quasi-crimes consists in making good the damages, with interest.

QUASI-MODO SUNDAY, *Low Easter-Sunday*, or the next Sunday after Easter; thus called from the initial words of the introit of the mass for the day, *Quasi modo geniti infantes*.

In the ancient deeds these words are signified by *q. m. g.*

QUASS, the name of a liquor in Russia, which serves the natives not only for drink, but also for sauce to a number of dishes; and is the basis of the favourite cold soup of the North, which is made by adding cold meat cut in pieces, with cucumbers salted after a peculiar manner, or with onions, or garlick, to a bowl of this subacid liquor. The common Russian quass is prepared by putting into a large pot full of cold water as much rye-flower as will make a thin dough; this is then placed in an oven moderately heated, for three hours, and afterwards taken out and thrown into

a tub of cold water; the mixture is worked with a machine like a chocolate mill till it froths. To this liquor are added two basons of the grounds of old quass, leaven, or a piece of their four bread; and the tub is covered with a cloth, and laid by till the liquor has acquired a fourish taste, which marks its being ready for use.

There is a better sort of quass, which is prepared as follows. Take a chetverik (about 35 pounds Russl. or 30 pounds Engl.) of barley-malt, two or three handfuls of rye-malt, and a like quantity of unbolted rye-meal; mix them all together in earthen pots, then pour boiling water upon it, and stir the whole till it acquires the consistence of a thin pap. The pots must be full to within an inch of the brim. Upon this mixture must now be poured about an inch in height of the husks of oats, from which groats are made. Set the pots in a heated oven, in which some glowing coals are still remaining, which must be heaped about the pots. This done, close the oven, and leave the pots in it four-and-twenty hours. This time being elapsed, take them out; again pour boiling water in till they are brimfull, and stir all well together. Now pour it all into a wooden vessel or tub, provided with a spigot and socket, first covering the bottom with a layer of straw, as is usually done in brewing beer; then add warm water, more or less, according to the quantity of quass you want; let it stand an hour, and afterwards draw it off into vessels. In every vessel a slice of coarse rye bread must be put, in order to make it ferment. Set the vessels in a cellar, and after four-and-twenty hours the quass is fit for drinking.

In making quass, barley-malt alone may be used. The rye-malt is added only from necessity, when the former, by itself, would be too poor, and not be sufficiently sweet. But the rye-meal is absolutely necessary.

From the quantity of malt and meal above stated, is obtained about six or seven kilderkins, or two ankers of quass. The Russians in the summer season put the vessels of quass immediately in the cellar, but in the winter they let them stand a whole night in a warm room, for the quass to ferment.

QUASSE, in *Geography*, a town of Africa, in Benin. N. lat. 6° 20'. E. long. 3° 30'.

QUASSIA, in *Botany*, received that name from Linnaeus. He called it so in honour of Quassi, a negro at Surinam, who discovered the virtues of the wood of this tree, in curing the malignant fevers of that country, to which so many Europeans fell a sacrifice, and who communicated this valuable discovery to his patron governor Dahlberg. Hence it became known in Europe; particularly by means of a dissertation printed in the *Amoenitates Academicæ*, first published in 1763.—Linn. Gen. 212. Schreb. 288. Willd. Sp. Pl. v. 2. 567. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 3. 42. Juss. 282. Lamarck Illustr. t. 343. Gærtn. t. 70.—Class and order, *Decandria Monogynia*. Nat. Ord. *Magnoliiæ affinis*, Juss.

Gen. Ch. *Cal.* Perianth inferior, very short, of five ovate, permanent leaves. *Cor.* Petals five, sessile, equal, lanceolate, elongated, oblique, converging. Nectary of five ovate villous scales, attached to the inside of the filaments at the base. *Stam.* Filaments ten, thread-shaped, equal, the length of the corolla; anthers oblong, incumbent. *Pist.* Receptacle fleshy, elevated, orbicular, broader than the germen. Germen ovate, composed of five separate ones; style thread-shaped, with five furrows, the length of the stamens; stigma with five angles. *Peric.* Drupas five, distant, horizontal, ovate, obtuse, splitting into two parts, all standing on a fleshy pentagonal receptacle. *Seeds* solitary, globose or oval.

Obs. Some flowers have abortive germens, others imperfect anthers.

QUASSIA.

Eff. Ch. Calyx of five leaves. Petals five. Nectary of five scales. Drupac five, distant, two-valved, single-seeded, placed on a fleshy receptacle.

1. *Q. amara*. Bitter Quassia. Linn. Sp. Pl. 553. Suppl. 235. Amoen. Acad. v. 6. 416. t. at page 429. Willd. n. 1. Ait. n. 1. Curt. Mag. t. 497. Woodv. Med. Bot. t. 77.—Flowers all perfect. Leaves pinnate; leaflets opposite, sessile; common stalk jointed, winged. Flowers racemose.—Native of Surinam. Introduced in 1790, by Mr. Alexander Anderson, to the stoves at Kew, where it flowers in June and July. A *shrub* rather than a tree, whose wood is intensely bitter. *Leaves* alternate; of two pair of *leaflets*, with an odd one, all elliptic-lanceolate, pointed, entire, veiny, very smooth, two or three inches in length, on a linear winged stalk, abrupt and jointed at the insertion of each pair. *Clusters* long, drooping one way. *Flowers* numerous, above an inch long, not much expanded, of a rich scarlet, as well as their stalks. The younger Linnæus errs in saying, in the Supplement, that the branch figured in Am. Acad. does not belong to the flowers.

This is the true original Quassia, whose wood is more powerful than that of the other species; but being very rare, and of small bulk, its place is said to be usually supplied by *Q. excelsa* hereafter described.

2. *Q. Simaruba*. Wing-leaved Quassia. Linn. Suppl. 234. Willd. n. 2. Ait. n. 2. Woodv. Med. Bot. t. 76. (*Simarouba amara*; Aubl. Guian. v. 2. 859. t. 331, 332.)—Flowers monoecious. Leaves pinnate; leaflets alternate, not quite sessile; common stalk naked. Clusters paniced.—Native of various parts of the West Indies, in a sandy soil, flowering in November and December. It was sent to Kew in 1787, by Mr. Alexander Anderson, but has not blossomed there. This is a tall and stout tree, whose wood is hard, white, without any peculiar flavour. *Leaves* alternate, with six, seven, or eight alternate obovate, rather narrow, entire, stalked *leaflets*, two inches long, whitish beneath; their common stalk simple, roundish. *Flowers* yellowish-white, much smaller than the preceding, either monoecious, or, as some say, dioecious, in branched or paniced clusters. The bark of the *root* is bitter, and much celebrated as a cure for the dysentery. Dr. Wright has given a full history of the plant, with a plate, in the Transactions of the Royal Society of Edinburgh, vol. ii. It is known in Jamaica by the name of Mountain Damson, Bitter Damson, and Stave-wood. In that island, according to Dr. Wright, the male flowers are never found on the same tree with the female.

3. *Q. excelsa*. Lofty Quassia. Swartz in Stockh. Transf. for 1788. 302. t. 8. Ind. Occ. v. 2. 742. Willd. n. 3.—Flowers polygamous. Stamens five. Leaves pinnate; leaflets opposite, stalked; common stalk naked.—Native of rather mountainous woods, in Jamaica and the Caribbean islands. The English commonly call it bitter wood, or bitter ash. The *tree* is lofty, with a very straight trunk; the wood whitish, moderately close-grained, very bitter; frequently sold by the druggists for the true *Quassia amara*, and found useful in intermittent fevers, debility of the stomach, worms, dropsy, and chlorosis. It is also used for making cabinets, for preserving insects, or other natural curiosities; this wood being supposed inaccessible to worms. The *leaves* are larger than the last, and composed of from four to six pair of opposite, elliptical, pointed, firm, entire, smooth leaflets, on short partial stalks. *Clusters* paniced, bearing very numerous, small, pale *flowers*, some male, the rest hermaphrodite, in the same cluster. Swartz describes the *nectary*, of five minute villous scales, contrary to the remark of Willdenow, under his *Zwingera*, Sp. Pl.

v. 2. 569, where it is said to be wanting in this species of *Quassia*. The *stamens* are mostly five, rarely four or six. *Germens* from two to four.

QUASSIA *Amara*, bitter quassia, in the *Materia Medica*. The root, bark, and wood of this tree are all comprehended in the catalogues of the *Materia Medica*; and it is observed that the leaves, flowers, &c. possess similar qualities. The roots, being perfectly ligneous, may be medically considered in the same light with the wood, which is now most generally employed, and seems to differ from the bark in being less intensely bitter; so that the latter is thought to be a more powerful medicine. The wood is sent to this country from Jamaica and the Caribbean islands in billets; and is reduced to chips, or rasped by the druggists. Quassia has no sensible odour; its taste is that of a pure bitter, more intense and durable than that of any other substance. It imparts its virtues more completely to watery than to spirituous menstrua, and its infusions are not blackened by the addition of martial vitriol. When the infusion is evaporated to dryness, it leaves a brownish-yellow, somewhat transparent, brittle extract, which has been regarded as a vegetable constituent *sui generis*, and named the bitter principle. (Edinb. Phil. Transf. iii. 207.) The infusion is rendered muddy by nitrate of silver, and a soft, flaky, yellow precipitate is formed; acetate of lead occasions a copious white precipitate; and hence it has been inferred that these salts are incompatible in formula with it. The watery extract is from a sixth to a ninth of the weight of the wood; the spirituous about a twenty-fourth.

Quassia derived its name, as has been already observed, from a negro named Quassi (by Fermin written Coissi, and by Rolander, Quass), who employed it with uncommon success as a secret remedy in the malignant, endemic fevers, which frequently prevailed at Surinam. In consequence of a valuable consideration, this secret was disclosed to Daniel Rolander, a Swede, who brought specimens of the quassia-wood to Stockholm in the year 1756; and since that time the effects of this drug have been very generally tried in Europe, and numerous testimonies of its efficacy published by many respectable authors. Its antiseptic powers have been submitted to various trials, from which it has been concluded, that it has considerable influence in retarding the tendency to putrefaction; which, in professor Murray's opinion, cannot be attributed to its sensible qualities, as it possesses no astringency whatever, nor to its bitterness, as gentian is much more bitter, but less antiseptic. The medicinal virtues ascribed to quassia are those of a tonic, stomachic, antiseptic, and febrifuge: it has been found very effectual in restoring the tone of the stomach, producing appetite for food, assisting digestion, expelling flatulency, and removing habitual costiveness, produced from debility of the intestines, and common to a sedentary life. Dr. Lettsom observes, that in hysterical atony, to which the female sex is so prone, the quassia affords more vigour and relief to the system than the Peruvian bark, especially when united with the vitriolum album, and still more with the aid of some absorbent. In dyspepsia, arising from hard drinking, and also in diarrhoeas, he exhibited the quassia with great success. Although he does not concur in opinion with Linnæus, who says, "me quidem judice chinchinam longè superat;" yet he has met with several instances of low remittent and nervous fevers, the symptoms of which the bark uniformly aggravated, though administered in intermissions the most favourable to its success, in which quassia, or snake-root, was successfully substituted. In such cases, he mostly observed that there was great congestion in the hepatic system, and the debility at the same time discouraged copious evacuations. And in many fevers, without evident remissions

remissions to warrant the use of the bark, whilst, at the same time, increasing debility began to threaten the life of the patient, the doctor found that quassia, or snake-root, singly or combined, upheld the vital powers, and promoted a critical intermission of fever, by which an opportunity was offered for the bark to effect a cure. Dr. Cullen says, (Mat. Med. vol. ii. p. 174.) "I believe quassia to be an excellent bitter, and that it will do all that any pure and simple bitter can do; but our experience of it in this country does not lead us to think it will do more; and the extraordinary commendations given of it are to be ascribed to the partiality so often shewn to new medicines." It is said to have been given, combined with nitric acid, with evident benefit in typhus, and also in fluor albus. It may be given in infusion, which is the best form of administering it; or in pills made from the watery extract. It may also be given in substance in doses of from grs. x to 3j three or four times a day. The official preparations are the "infusum quassiae" of the London Pharmacopeia, and the "tinctura quassiae" of that of Dublin. The infusion is prepared by macerating for two hours in a lightly covered vessel a scruple of quassia-wood, chipped, in half a pint of boiling water, and straining. In hysteria, this may be combined with purgatives and tincture of valerian; in atonic gout, with aromatics; and in dyspeptic affections, with chalybeates, sulphate of zinc, or mineral acids. The dose is from fʒj to fʒiij, given twice or thrice a day. The tincture is prepared by digesting for seven days an ounce of chips of quassia-wood in two pints of proof spirit; and then straining. This may be used in the same cases as the infusion.

It is asserted that the brewers have, of late years, used quassia-wood instead of hops. Beer made with it certainly does not keep, says Thomson, but soon becomes muddy and flat, has a mawkish taste, and runs into the acetous fermentation. It is consequently less nutritious and wholesome than that which is properly hopped. Wood. Mat. Med. Thomson's Lond. Disp.

QUASSIA *Simaruba*. See SIMARUBA.

QUATCHEOU, in *Geography*, a town of Asia, in the country of Hami; 30 miles E. of Tche-tcheou. N. lat. 40° 28'. E. long. 94° 27'.

QUATER-COUSINS, QUATRE-COUSINS, fourth cousins, or the last degree of kindred.

Hence, when persons are at variance, it is said they are not quater, or cater-cousins.

QUATERNA FOLIA, among *Botanists*. See LEAF.

QUATO, in *Zoology*. See SIMIA *Paniscus*.

QUATORZIEME, Fr., the 14th, or double octave of the 7th. It is called the 14th, because 14 sounds must be formed to pass diatonically from one of its terms to the other.

QUATOTOMOMI, in *Ornithology*, the name of an American bird of the wood pecker kind, having a red crest on its head, and two white lines running down the sides of the neck to the breast. It is called by Nieremberg *Picus imbricatus*; which see.

QUATOZTUI. See TANAGRA *Leucocephala*.

QUATRE FACARDINS, Les, in *Geography*, four small islands in the South Pacific ocean, so named by M. Bougainville, in the year 1768. S. lat. 18° 40'. W. long. 140° 30'.

QUATREFOIL, a decoration resembling a rose with four leaves, which constantly occurs in pointed architecture.

QUATRE-NATIONS, *q. d.* Four Nations, the denomination of a college founded in 1661, by cardinal Mazarin, for the education and maintenance of sixty children, Ver. XXIX.

natives of the four countries conquered by Lewis XIV., viz. fifteen for Pignerol and Italy, fifteen for Alfatia, twenty for Flanders, and ten for Roussillon.

QUATRICHROMA, in the *Italian Music*, is what we call a *semi-semi-quaver*, thirty-two of which make a bar in common time. See TIME, and TRIPLE.

QUATRO CASE, in *Geography*, a town of Italy, in the department of the Mincio; 17 miles S.E. of Mantua.

QUATROL, a small island in the gulf of Siam, near the coast of Camboja. N. lat. 10° 13'. E. long. 103° 25'.

QUATROS, CORONADOS, Los, an island in the Pacific ocean, discovered by Quiros in 1606. S. lat. 18° 40'.

QUATTRINO, in *Commerce*, a copper coin at Florence; also a money of account, 60 quattrini being equal to 12 crazie, 1½ paoli, or 2 lira. At Rome, the scudo is divided into 3½ testoni, 500 quattrini, or 1000 mezzì quattrini; so that 5 quattrini make 1 paolo, and 3 paoli 1 testone. See SCUDO.

QUATUOR, Lat., a name given to any musical composition, vocal or instrumental, in four parts, and in dialogue, or a *parte eguale*, when each have solo parts alternately. The Italians sometimes call a quatuor *quartello*, but more frequently *quartito*, and the English *quartet*.

A vocal quartet, says Rousseau, is more difficult for the poet to write, as well as for the composer to set, than a trio or chorus,

In the vocal quartet of a musical drama, four distinct characters should be supported both in the words and music, according to the situation and state of mind of the several personages who have petitions or complaints to make, or answers to give.

The instrumental quartets of Haydn have been the delight of all that have performed, or heard them performed, for full 30 years, and bid fair to continue to afford delight for at least 30 years more.

QUATUOR *Principalia Artis Musicae*, the title of a MS. in the Bodleian library at Oxford (Digby 90.), which has been ascribed to several authors. Anthony Wood gives it to Tewkesbury, to whom it is likewise ascribed in the Oxford Catalogue of MSS., with very little foundation. Bishop Tanner has honoured Dr. John Hambois with this production, a writer on music, who flourished more than a century after this MS. was finished, as appears from the testimony of the scribe himself.

There is, however, at Oxford, among the MSS. another volume of Musical Tracts (Bodl. 515.), which had not been sufficiently examined by any of the cataloguers who have mentioned it: for, on a careful perusal and collation, we found in it, besides two other tracts by Simon Tunstede, or Tunstede, a duplicate of the Quatuor Principalia; and as no doubt has been thrown upon Tunstede having been the author of the two first tracts in the volume, it seems as if we might venture, without doubt or hesitation, to assign to him this ample, and, for the time when it was written, excellent treatise. That Simon Tunstede was a man of science, and an able musician, as well as a doctor of divinity, appears at the end of MS. Digby 90. After saying that the book was finished in 1351, we have the following passage: "Ille autem anno regens erat inter minores Oxoniæ fratres, Simon de Tunstede, doctor sacre theologie, qui in musica pollebat, et eciam in septem liberalibus artibus." Pits, Bale, Tanner, and all our biographical writers, speak of him as a learned musician; and Pits enumerates the Quatuor Principalia among his writings. (De illust. Angl. Script.) Simon Tunstede, a Franciscan friar, born at Norwich, was in such favour for his learning and piety, as to

be unanimously chosen provincial master of all England. He died at Brizard, in Suffolk, in 1369.

The title of the tracts in the Oxford Catalogue of MSS. has occasioned the great diversity of opinions about the writer of the *Quatuor Principalia*; for N° 515 is entitled "De Musica continua et discreta, cum Diagrammatibus, per Simonem Tunstede, A.D. 1351." However, in the beginning of the volume, the author proposes to treat "De quatuor Principalibus in quibus totius Musica radices consistunt," &c. which exactly agrees with the other MS.; and there is no difference from the beginning to the end, except in the omission of a kind of prologue, or argument to the work, which appears in the tract ascribed to Tewkesbury (Digby 90.), beginning "Quemadmodum inter Triticum," and is omitted in that to which the name of Tunstede is prefixed. Bodl. 515.

What the author calls the "Four Principals of Music," will best appear from his own manner of dividing the work. In the first part or principal, consisting of nineteen chapters, he treats of music in general, its constituent parts and divisions. II. Of its invention, intervals, and proportions, twenty-four chapters. III. Of plain chant, and the ecclesiastical modes, fifty-eight chapters. IV. Of measured music, or time; of discant, and their several divisions. This last principal is divided into two sections, of which the first contains forty-one chapters, and the second forty-nine. The whole treatise fills a hundred and twenty-four folio pages; the diagrams, which are very numerous, are beautifully written, and illuminated with different coloured inks; and it seems to be in all respects the most ample and complete work of the kind which the fourteenth century can boast.

QUATUOR Hominis Prepositi. See PREPOSITI.

QUATUOR-VIR, in *Antiquity*, frequently written *III. VIR*, a Roman magistrate, who had three colleagues joined with him in the same administration.

To the quatuor-vir was committed the charge of conducting and settling the colonies sent into the provinces.

Upon unlucky accidents, and other dangerous affairs, it was usual to create quatuor-viri, with commission to take care *ne quid detrimenti respublica caperet*, that the republic were not prejudiced.

There were also quatuor-viri appointed to inspect and take care of repairs, &c.

QUAUCHOCHOPITLI, in *Ornithology*. See *PICUS Tricolor*.

QUAVER, in *Music*, a measure of time, equal to one-half of the crotchet, or one-eighth of the semi-breve.

The quaver is marked by the character 

The English quaver makes what the French call *crochue*, crotchet, because of the hook at bottom. See *CROTCHET*.

The quaver is divided into two semiquavers, noted  and four demisemiquavers, marked . See *CHARACTERS*.

QUAVERING, the act of trilling, or shaking; or the running a division with the voice.

QUAUHAYOHUATLI, in *Botany*, a name by which some authors have called the tree, whose fruit is the cassia fistula of the shops. Hern. p. 87.

QUAUHCILUI, in *Ornithology*. See *MEROPS Cinnereus*.

QUAUHIOYAMATL, in *Zoology*. See *SUS Tajassu*.

QUAUHTECALLOTLQUAPACHTLI. See *SCIURUS Variegatus*.

QUAUHTECHALOTT-THLITIC. See *SCIURUS Niger*.

QUAUHTLA-COYMATL. See *SUS Tajassu*.

QUAUHTZONECOLIN, in *Ornithology*, the American name for a bird called by most a quail, but esteemed by Nieremberg a species of partridge.

It is of the size of the European partridge, and of a brownish colour, and ornamented with a crest upon its head.

There are also in America two other species of partridge much allied to this: the one with a yellow body, and black and white head; the other small and brown, and without a crest. See *TETRAO Crijlatus*.

QUAUHYAC OCULENSIUM, in *Botany*, the name of a very large Indian tree, bearing leaves resembling those of the citron. The bark is astringent, heating, drying, and of a strong smell: it restrains a diarrhoea, and excites a sweat. The juice, snuffed up the nose, causes sneezing, purges the head, and thus removes fevers, and pains in the head: for which reasons, it is preserved in families as a popular remedy. Nieremberg.

QUAVITL, a name given by some authors to the cocoa-tree. Hern. p. 79.

QUAUTOTOPOTLI, in *Ornithology*. See *PICUS Canadensis*.

QUAY, *KAY*, a space of ground paved on the shore of a river, or port, destined for the loading and unloading of merchandize. See *KAY* and *WHARF*.

QUEAGA, in *Geography*, a town of Pegu, on the Ava; 18 miles S. of Lundsey.

QUEBEC, a city of America, the capital of the lower province of Canada, as Niagara is of the upper, was founded by the French in the year 1608, and is situated on a very lofty point of land, on the N.W. side of the river St. Lawrence, at its confluence with the river St. Charles, about 320 miles from the sea. Nearly facing it, on the opposite shore, there is another point; and between the two the river is contracted to the breadth of three-quarters of a mile; but after passing through this strait, it expands to the breadth of five or six miles, taking a great sweep behind that point on which Quebec stands. The city derives its name from the word *Québec*, or *Quebeio*, which, in the Algonquin tongue, signifies a sudden contraction of a river. The wide part of the river, immediately before the town, is called "the Basin," and it is sufficiently deep and spacious to float upwards of 100 sail of the line. Quebec is divided into two parts, called the upper and the lower towns. The upper town is situated on a rock of limestone, on the top of the point; and the lower town, built round the bottom of the point, close to the water, on land which has been gradually gained from the river. The rock on which the upper town stands rises, in some places towards the water, nearly perpendicularly, so as to be totally inaccessible; in other places it is not so steep as to prevent a communication between the two towns, by means of streets winding up the side of it; though here the ascent is so great, that there are long flights at one side of the streets, for the accommodation of foot-passengers. The lower town lies very much exposed to an enemy, being defended merely by a small battery towards the basin, which, at the time of high tides, is nearly on a level with the water; and by barriers towards the river, in which guns may be planted, when there is any danger of an attack.

The upper part is a place of immense strength. Towards the water it is so strongly guarded by nature, that flight

QUEBEC.

slight walls are a sufficient defence; and in some places, where the rock is inaccessible, no walls are necessary. Here, however, are several redoubts and batteries. The principal battery, which points towards the bason, consists of twenty-two 24-pounders, two French 36-pounders, and two large iron mortars: this battery is flanked by another of six guns, that commands the passes from the lower town. On the land side the fortifications are stupendous. When general Wolfe attacked this place, he thought it a vain attempt to make an assault on the side of the town which lies towards the water, where the rock is so steep, and so easily defended. In order to carry on the attack on the land side, he first attempted to land his troops some miles below the town, near the Falls of Montmorenci; but here he was repulsed by a large division of the French forces with loss. Foiled in his first attempt to get on shore, the brave Wolfe formed the bold design of ascending to the top of the banks above Quebec, commonly called the Heights of Abraham. After previous preparation, the soldiers clambered up the heights with great difficulty, and the guns were hauled up by means of ropes and pulleys fixed round the trees, with which the banks are covered from top to bottom. At the top the plain commences, and extends close under the walls of the city. Here the memorable battle was fought, in which the much lamented general fell, at the moment when all his noble exertions were about to be crowned with the success which they so eminently merited. The spot where the illustrious hero breathed his last is marked with a large stone, on which a true meridional line is drawn. Although the great Wolfe found it so difficult a task to gain possession of Quebec, and it has been rendered much stronger since his time, the people of the United States imagine, that, in case of a rupture with Great Britain, it might be easily taken; and yet at the close of the year 1775, and the commencement of 1776, an attempt was made by American troops, under the command of Arnold and Montgomery, without success. On this occasion Montgomery fell, and Arnold's attempt, on the practicability and success of which he had previously boasted, proved fruitless. St. John's gate, which he endeavoured to force, and the adjoining walls, are stupendous; and the mere sight of them may convince any person, that an attempt to storm them must be altogether ineffectual, without the aid of heavy artillery, with which the Americans were not provided.

Independently of its fortifications, and situation on the summit of a rock, Quebec owes much of its strength and security to the long duration and extreme severity of the winter; as in that season it is wholly impracticable for a besieging army either to carry on any works, or to blockade the town. Mr. Weld says, that 5000 soldiers are necessary to man the works at Quebec completely. A large garrison is always kept in it, and abundance of stores of every description. The troops are lodged partly in barracks, partly in block-houses near Cape Diamond, which is the most elevated part of the point, and is reckoned to be upwards of 1000 feet above the level of the river. The Cape is strongly fortified, and may be considered as the citadel of Quebec: it commands the town in every direction, and also the plains on the outside of the walls. The evening and morning guns, and all salutes and signals, are fired from hence. Notwithstanding the great height of the rock above the river, water may be readily obtained even at the very top of it, by sinking wells of a moderate depth; and in some particular places, at the sides of the rock, it gushes out in large streams; and the water is of a very good quality. It is supposed, says Mr. Weld, that including the upper and

lower towns and suburbs, there are at least 2000 dwellings; and the number of inhabitants, allowing six to a house, may be estimated at 12,000. Mr. Heriot says, that, in 1806, the number of inhabitants amounted to 15,000; and if this statement be correct, the increase must have been very rapid, for, in the year 1784, Quebec contained only 6472 inhabitants. About two-thirds of the inhabitants are of French extraction. The society is agreeable, and very extensive for a place of its size, which is owing to its being the capital of the lower province, and therefore the residence of the governor, different civil officers, principal lawyers, &c. The large garrison always maintained in it contributes to make it gay and lively.

The lower town is mostly inhabited by the traders who are concerned with the shipping, and it is a very disagreeable place. The streets are narrow and dirty, and, on account of the height of the houses in most of them, the air is much confined; and in the streets next the water, there is an intolerable stench from the shore when the tide is out. The upper town, on the contrary, is extremely agreeable; from its elevated situation, the air is very pure, and the inhabitants are never oppressed with heat in summer; it is, however, far from being well laid out, the streets being narrow and very irregular. The houses are generally built of stone, and, except some few, built of late years, small and inconvenient. The chateau, in which the governor resides, is a plain building of common stone, situated in an open place, the houses round which form three sides of an oblong square. It consists of two parts. The old and the new are separated from each other by a spacious court. The former stands just on the verge of an inaccessible part of the rock; behind it, on the outside, there is a long gallery, from whence, if a pebble were let drop, it would fall at least sixty feet perpendicularly. This old part is chiefly taken up with the public offices, and all the apartments in it are small and ill contrived; but in the new part, which stands in front of the other, facing the square, they are spacious, and tolerably well finished, but none of them can be called elegant. This part is inhabited by the governor's family. The chateau is built without any regularity of design, neither the old nor the new part having even an uniform front. It is not a place of strength, as commonly represented. In the garden adjoining to it is merely a parapet wall along the edge of the rock, with embrasures, in which a few small guns are planted, commanding a part of the lower town. Every evening during summer, when the weather is fine, one of the regiments of the garrison parades in the open place before the chateau, and the band plays for an hour or two, at which time the place becomes the resort of numbers of the most genteel people of the town, and has a very gay appearance.

Opposite to the chateau there is a monastery belonging to the Recollets, or Franciscan friars; a very few only of the order are now left. Contiguous to this building is the college belonging to the Jesuits, whose numbers have diminished even still faster than that of the Recollets.

The nunneries are three in number, and as there is no restriction upon the female religious orders, they are all well filled. The largest of them, called L'Hospital General, stands in the suburbs, outside of the walls; another, of the order of St. Ursule, is not far distant from the chateau.

The engineer's drawing-room, in which is kept a variety of models, together with plans of the fortifications of Quebec and other fortresses in Canada, is an old building, near the principal battery. Adjoining to it stands the

house where the legislative council and assembly of representatives meet, which is also an old building, that has been plainly fitted up to accommodate the legislature.

The armoury is situated near the artillery barrack, in another part of the town. About ten thousand stand of arms are kept in it, arranged in a similar manner with the arms in the Tower of London, but, if possible, with greater neatness and more fancy.

The artillery barracks are capable of containing about five hundred men, but the principal barracks are calculated to contain a much larger number; they stand in the market-place, not far distant from the square in which the chateau is situated, but more in the heart of the town.

The market of Quebec is extremely well supplied with provisions of every kind, which may be purchased at a much more moderate price than in any town visited by Mr. Weld in the United States. It is a matter of curiosity to a stranger to see the number of dogs yoked in little carts, that are brought into this market by the people who attend it. The Canadian dogs are found extremely useful in drawing burthens, and there is scarcely a family in Quebec or Montreal, that does not keep one or more of them for that purpose. They are somewhat similar to the Newfoundland breed, but broader across the loins, and have shorter and thicker legs; in general they are handsome, and wonderfully docile and sagacious; their strength is prodigious. A single dog will draw a man for a considerable distance, that could not weigh less than ten stone. People, during the winter season, frequently perform long journeys on the snow with half a dozen or more of these animals yoked in a cariole or sledge.

An attempt was made in 1711 by the English and Americans, under the command of brigadier Hill, to surprise Quebec; but it proved abortive. In 1759 it was taken by the English, under the command of the valiant Wolfe, who sacrificed his life in the engagement; and by the peace, in 1763, it was ceded, with the rest of Canada, to the conquerors, in whose possession it has since continued.

The scenery that is exhibited to the view from various parts of the upper town of Quebec, surpasses for grandeur, beauty, and diversity, any other, as Mr. Weld says, that he has seen, either in America, or in any other part of the globe. In the variegated expanse that is laid open before you, stupendous rocks, immense rivers, trackless forests, and cultivated plains, mountains, lakes, towns, and villages, in turn strike the attention, and the senses are almost bewildered in contemplating the vastness of the scene. Nature is here seen on the grandest scale; and it is scarcely possible for the imagination to paint to itself any thing more sublime than are the several prospects presented to the sight of the delighted spectator. From cape Diamond, situated one thousand feet above the level of the river, and the loftiest part of the rock on which the city is built, the prospect is considered by many as superior to that of any other spot. A greater extent of country opens upon you, and the eye is here enabled to take in more at once, than at any other place; but it appeared to Mr. Weld, that the view from the cape is by no means so fine as that, for instance, from the battery; for in surveying the different objects below you from such a stupendous height, their magnitude is in a great measure lost, and it seems as if you were looking at a draft of the country, more than at the country itself. It is the upper battery that Mr. Weld alludes to, facing the basin, and is about three hundred feet above the level of the water. Here, if you stand but a few yards from the edge of the precipice, you may look

down at once upon the river, the vessels upon which, as they sail up to the wharfs before the lower town, appear as if they were coming under your very feet. The river itself, which is between five and six miles wide, and visible as far as the distant end of the island of Orleans, where it loses itself amidst the mountains that bound it on each side, is one of the most beautiful objects in nature, and on a fine still summer's evening it often wears the appearance of a vast mirror, where the varied rich tints of the sky, as well as the images of the different objects of the banks, are seen reflected with inconceivable lustre. The southern bank of the river, indented fancifully with bays and promontories, remains nearly in a state of nature, clothed with lofty trees; but the opposite shore is thickly covered with houses, extending as along other parts of the river already mentioned, in one uninterrupted village, seemingly, as far as the eye can reach. On this side the prospect is terminated by an extensive range of mountains, the flat lands situated between and the villages on the banks not being visible to a spectator at Quebec, it seems as if the mountains rose directly out of the water, and the houses were built on their steep and rugged sides.

Beautiful as the environs of the city appear when seen at a distance, they do not appear less so on a more close inspection; and in passing through them the eye is entertained with a most pleasing variety of fine landscapes, whilst the mind is equally gratified with the appearance of content and happiness that reigns in the countenances of the inhabitants. Indeed, if a country as fruitful as it is picturesque, a genial and healthy climate, and a tolerable share of civil and religious liberty, can make people happy, none ought to appear more so than the Canadians. There are, however, in the vicinity of Canada two scenes, more particularly deserving of attention than any others: these are the falls or cataracts of the rivers *Cbaudiere* and *Montmorency*; which see respectively. N. lat. 46° 48' 38". W. long. 71° 5' 29". Weld's Travels, vol. i.

QUEBITEA, in *Botany*, a name which seems to have been whimsically extracted by Aublet, from the Caribbean appellation of this plant, *Daquejoabite*. Aubl. Guian. v. 2. 838. t. 327. This has many creeping roots, and a twisted, decumbent, hairy stem, with alternate, elliptical, broad, entire, hairy leaves, three or four inches long, on hairy footstalks. Flowers minute, in short, dense, axillary, stalked spikes, with a small scale at the base of the stalks. Aublet did not investigate the structure of these flowers, but he suspects the plant to be nearly akin to *Dracontium*, under which genus it is accordingly noticed by Jussieu. The roots, when chewed, are very acrid. The bruised herb is used externally, to cure the bite of serpents. It grows on the banks of rivulets in Guiana.

QUEBRANTAHUESSOS, in *Ornithology*. See PROCELLARIA *Gigantea*.

QUECALA, in *Geography*, a town of Mexico, in the province of Mechoacan; 105 miles S.S.E. of St. Luis de Potosi.

QUECHUA, in *Literary History*. See PERU.

QUEDA, a sea-port city on the W. coast of the peninsula of Malacca, the capital of a kingdom, tributary to Siam, with a good harbour at the mouth of a river that will admit a vessel drawing 12 or 14 feet water on the springs over the bar, which is gravel and mud. The town contains about 400 houses, inhabited by Chinese and Malays. The environs are agreeable and fertile; the woods abound in elephants and other animals, and in some places are mines of lead, which supply large quantities of those metals for exportation to Hindoostan, Arabia, and Persia. The government

vernment is monarchical, under a Malay Mahomedan prince, who, like many other Malay princes, engrosses almost the whole foreign trade of the port, excepting that of an annual Chinese junk, which pays a certain sum only as duty, and then has leave to trade freely with the inhabitants. This junk imports immense quantities of coarse China-ware, thin iron pans, and many other articles from that country, and exports biche de mer, called swallow, sharks' fins, edible bird's nests, rattans, tin, rice, dammer, tortoise-shell, deer's skins and sinews, bullocks and buffalos' hides and horns, jerked beef, and many other coarse articles. At Queda there is great plenty of rice, bullocks, buffalos, and poultry; but not such abundance of fruit and vegetables as at Acheen. The territory of Queda is a flat country, favourable for the cultivation of rice; a hill north of the town and inland, called the Elephant, favours the navigator's approach; also the small islands called Peers, 20 miles west of the bar, covered with trees, and good regular mud soundings, a great way off, even by night, indicate the distance to the mariner; 300 miles E.N.E of Acheen. N. lat. 6° 20'. E. long. 100° 18'.

QUEDENAU, a town of Prussia, in Samland; three miles N. of Königsberg.

QUEDLINBURG, a town of Westphalia, in the principality of Halberstadt, on the Bode, which divides it into the Old and New Towns. It has several churches, a hospital, and a college. Near this town is a princely abbey, situated on a hill: it was founded by king Henry I. between the years 932 and 936, and since enriched by various endowments. In 1539 it embraced Lutheranism, and obliged itself, by solemn oaths, to maintain that form of religion. It lately consisted of four dignitaries, viz. of the lady abbess and three others, distinguished by the titles of provost, dean, and canon. In 1802, the abbey and its revenues were voted to the king of Prussia, as an indemnity; and by the treaty of Tilsit, transferred to the kingdom of Westphalia. The town of Quedlinburg is seven miles S.S.E. of Halberstadt. N. lat. 51° 48'. E. long. 11° 20'.

QUEDLITZ, a town of Prussia, in the province of Ermeland; four miles S. of Wartenburg.

QUEECE, in *Agriculture*, a term sometimes provincially applied to the wood-pigeon, or birds of that kind.

QUEECHY, in *Geography*, a river of Vermont, which runs into the Connecticut at Hartland.

QUEEN, REGINA, a woman who holds the crown of a realm singly, and by right of blood.

The word queen is derived from the Saxon *cwen*, *uxor*, *the wife of any one*, but applied, by way of excellency, to the wife of the king only; whence she was anciently called the *king's queen*; the West Saxons having no other name for a queen but the *king's wife*. (Aster de Ælfred, rebus, &c.) She was also called *lady*, in Saxon *wælaflic*; just as *madame*, *mademoiselle*, were used in France, for the wife and daughter of the duke of Orleans.

The name queen is also given, by way of courtesy, to her that is married to the king; called, by way of distinction, *queen consort*. In respect of whom the former is called *queen regnant*, or regent.

The widow of a king is also called queen, but with the addition of *dowager*.

In the first sense, queen is, in all construction, the same with king; and has the same powers, prerogatives, rights, dignities, and duties that the king has. This is expressly declared by statute 1 Mar. I. st. 3. c. 1.

The *queen consort* is inferior, and a person distinct from, and a subject of, the king. In England, though she be a feme-covert, yet may she sue, and be sued, in her own

name; and may make leases, and grants, &c. as a feme-sole.

She has several other prerogatives. Though an alien, she may purchase lands in fee-simple, without either naturalization, or denization; she may present to a benefice; nor is plenarty a bar against her more than against the king. She is also capable of taking a grant from the king, which no other wife can do from her husband; and she may have a separate property in goods as well as lands, and has a right to dispose of them by will. She pays no toll, and shall not be amerced, if she be nonsuited in any action; and may not be impleaded till first petitioned.

To conspire her death, or violate her chastity, is high treason. She has an ancient peculiar revenue, called *queen-gold*; besides a very large dower, with a royal court, and officers, distinct from the king's; and her attorney and solicitor-general are entitled to a place within the bar of his majesty's courts, together with the king's counsel.

Another ancient prerogative belonging to the queen consort, mentioned by all our old writers, and, on this account only, worthy of notice, is this, that on the taking of a whale on the coasts, which is a royal fish, it shall be divided between the king and queen; the head only being the king's property, and the tail of it the queen's. One reason of this whimsical division, as assigned by our ancient records, was to furnish the queen's wardrobe with whalebone.

The *queen dowager*, as the widow of the king, enjoys most of the privileges belonging to her as queen consort. But it is not high treason to conspire her death; or to violate her chastity, because the succession to the crown is not thereby endangered. Yet still, *pro dignitate regali*, no man can marry a queen dowager without special licence from the king, on pain of forfeiting his lands and goods. She has also this particular, that she loses not her dignity, though she marry a private gentleman; as peeresses dowager do their peerage, when they marry commoners. Thus queen Catherine, widow of Henry V. being married to Owen ap Tudor, esq. maintained an action as queen of England. Much less does a queen regnant follow her husband's condition, or is subject to other queens; but she is sovereign to her own husband, as queen Mary was to king Philip, and queen Anne to prince George of Denmark; unless it be otherwise appointed by parliament. The husband may be guilty of high treason against her; but in the instance of conjugal infidelity, he is not subject to the same penal restrictions. For which the reason seems to be, that if a queen consort is unfaithful to the royal bed, this may debase or bastardize the heirs to the crown; but no such danger can be consequent in the infidelity of a husband to a queen regnant.

QUEEN CAROLINE, in *Biography*, when princess of Wales, is told in the dedication of the opera of Julius Cæsar to her royal highness, that the first musical sounds which her highness heard, were those produced by the voice of the celebrated Pistocio, the father of good taste, then in the service of his illustrious sire, at the court of Anspach.

Music doubtless was a serious part of her majesty's education, as it is, and has ever been, of all the princes and princesses of Germany; who have likewise frequent opportunities of hearing great performers and splendid performances; yet we do not recollect having heard that her majesty was a performer herself, or even an admirer or patroness of the art. This princess died in November 1737.

QUEEN MARY. (See MARY.) During the short reign of this bigoted and intolerant princess, ecclesiastical music was again

again transferred to Latin words and the mafs, both of which had been excommunicated during the reign of her brother, Edward VI. But metrical psalmody had not yet been generally received in our parochial churches. Mary was herself a performer on the virginal and lute, as appears by a letter sent to her by her mother, queen Katherine, after her separation from the king, in which "she encourages her to suffer cheerfully, to trust to God, and keep her heart clean. She charged her in all things to obey the king's commands, except in matters of religion. She sent her two Latin books, the one 'De Vita Christi,' and the other the 'Epistles of St. Jerom;' in them, (says the queen,) I trust you shall see good things. And sometimes, for your recreation, use your virginals or lute, if you have any."

Fuller tells us, that "eight weeks and upwards passed between the proclaiming of queen Mary and her assembling the parliament; during which time two religions were together set on foot, *Protestantisme* and *Poperie*; the former hoping to be continued, the latter labouring to be restored;—and during this interim the churches and chapels in England had a mongrel celebration of their divine services betwixt reformation and superstition. For the obsequies for king Edward were held by the queen in the Tower, August 7th, 1553, with the dirige sung in Latin, and on the morrow a masse of requiem, and on the same day his corps were buried at Westminster with a sermon service, and communion in English."

In October following the laws of her predecessor, Edward, concerning religion, were all repealed. And in November 1554, bishop Bonner "set up the old worship at Paul's, on St. Katherine's day; and it being the custom, that on some holydays, the quire went up to the steeple to sing the anthems, that fell on that night:—and the next day, being St. Andrew's, he did officiate himself, and had a solemn procession."

After this period, during the subsequent years of Mary's reign, the public service was every where performed in the Roman Catholic manner, throughout the kingdom; and we may imagine that the numerous compositions to Latin words, which have been preserved of Dr. Tye, White, Tallis, Bird, and the rest of our most eminent harmonists, were produced and performed at this time, while the Romish religion had the ascendant. And indeed it appears by a record, now in the possession of the Antiquarian Society, that the list of Mary's chapel establishment contains nearly the same names as that of her brother Edward.

QUEEN ELIZABETH. (See ELIZABETH.) In speaking of music during the long and prosperous reign of queen Elizabeth, our nation's honour seems to require a more diffuse detail than at any other time: for perhaps we never had so just a claim to equality with the rest of Europe, where music was the most successfully cultivated, as at this period; when indeed there was but little melody any where. Yet, with respect to harmony, canon, fugue, and such laboured and learned contrivances as were then chiefly studied and admired, we can produce such proofs of great abilities in the compositions of our countrymen, as candid judges of their merit must allow to abound in every kind of excellence that was then known or expected.

Elizabeth, as well as the rest of Henry VIII.'s children, and indeed all the princes of Europe at that time, had been taught music early in life. For Camden, in giving an account of her studies, says, that "she understood well the Latin, French, and Italian tongues, and was indifferently well seen in the Greek. Neither did she neglect musicke,

so far forth as might become a princess, being able to sing and play on the lute prettily and sweetly."

There is reason to conclude, that she continued to amuse herself with music many years after she ascended the throne. Sir James Melvil gives an account of a curious conversation which he had with this princess, to whom he was sent on an embassy by Mary, queen of Scots, in 1564. After her majesty had asked him how his queen dressed? What was the colour of her hair? Whether that or her's was best? Which of them two was fairest? And which of them was highest in stature? "Then she asked, what kind of exercises she used?" I answered, says Melvil, "that when I received my dispatch, the queen was lately come from the Highland hunting: that when her more serious affairs permitted, she was taken up with reading of histories: that sometimes she recreated herself in playing upon the lute and virginals. She asked if she played well? I said, reasonably for a queen."

"The same day, after dinner, my lord of Hunfden drew me up to a quiet gallery, that I might hear some music, (but he said, that he durst not avow it,) where I might hear the queen play upon her virginals. After I had hearkened a while, I took by the tapestry, that hung before the door of the chamber, and seeing her back was toward the door, I entered within the chamber, and stood a pretty space hearing her play excellently well. But she left off immediately, so soon as she turned about and saw me. She appeared to be surpris'd to see me, and came forward, seeming to strike me with her hand; alleging, she used not to play before men, but when she was solitary, to shun melancholy. She asked how I came there? I answered, as I was walking with my lord Hunfden, as we passed by the chamber door, I heard such a melody as ravished me, whereby I was drawn in ere I knew how; excusing my fault of homeliness, as being brought up in the court of France, where such freedom was allowed; declaring myself willing to endure what kind of punishment her majesty should be pleas'd to inflict upon me for so great offence. Then she fate down low upon a cushion, and I upon my knees by her; but with her own hand she gave me a cushion, to lay under my knee; which at first I refused, but she compelled me to take it. She enquired whether my queen or she played best. In that I found myself obliged to give her the praise."

If her majesty was ever able to execute any of the pieces that are preserved in a MS. which goes under the name of "Queen Elizabeth's Virginal Book," she must have been a very great player: as some of these pieces, which were composed by Tallis, Bird, Giles, Fariaby, Dr. Bull, and others, are so difficult, that it would be hardly possible to find a master in Europe, who would undertake to play one of them at the end of a month's practice.

Besides the lute and virginals, Elizabeth was a performer on the violin, and on an instrument something like a lute, but strung with wire, and called the *poliphant*. A violin of a singular construction, with the arms of England, and the crest of Dudley, earl of Leicester, this queen's favourite, engraved upon it, was purchased at the sale of the late duke of Dorset's effects. The date of its make, 1578. It is very curiously carved; but the several parts are so thick and loaded with ornaments, that it has not more tone than a nut; or violin with a fordine; and the neck, which is too thick for the grasp of the hand, has a hole cut in it for the thumb of the player, by which the hand is so confined, as to be rendered incapable of shifting, so that nothing can be performed upon this instrument, but what lies within the reach of the hand in its first position. Playford

tells us, that "Queen Elizabeth was not only a lover of this divine science (music), but a good proficient therein; and I have been informed, (says he, by an ancient musician, and her servant, that she did often recreate herself on an excellent instrument, called the *poliphant*, not much unlike a lute, but strung with wire."

Among the Sloane MSS. in the British Museum, No 1520, there is a list of the officers of the court of revenue in this reign; in which is included the musical establishment of her majesty's household, about the year 1587.

Musitjcons.

The servant	-	-	Fee	24	6	8
Trompeters sixteen.	Fee to every of them			24	6	8

Lutes, harps, and fencers.

Chief luter	-	-	Fee	40	0	0
Chief harper	-	-	-	20	0	0
Reel of the luters	-	-	-	19	0	0
The other of the harps	-	-	-	9	0	0
And	-	-	-	8	0	0
Bagpiper	-	-	Fee	12	13	4
Minstrels nine, whereof seven at	-	-	-	18	5	0
every of them; one at	-	-	-	24	6	0
and thother at	-	-	-	66	0	8
Six children to sing	-	-	-	-	-	-
Rebeck two	-	-	Fee	28	6	6
Sackbutt six, whereof five having	-	-	-	24	6	8
by the year, and one at	-	-	-	36	10	0
Vials eight, whereof six at	-	-	-	30	8	4
one at	-	-	-	20	0	0
and thother at	-	-	-	10	0	0
Players on the virginalls three, one at	-	-	-	50	0	0
and thother two at	-	-	-	30	0	0
a piece.	-	-	-	-	-	-
Musitions straungers seven, whereof six have	-	-	-	30	10	0
and one	-	-	-	38	0	0
Drumfleds three, every of them	-	-	-	18	5	0
Players on the flute two, at	-	-	-	18	5	0
a piece.	-	-	-	-	-	-
Makers of instruments: Regall-makers	-	-	-	20	0	0
Players of enterludes eight, every of them p. ann.	-	-	-	66	0	8
Organ-maker	-	-	-	20	0	0

Her majesty's chapel establishment was nearly the same, in number and salaries, as that of her brother and sister, Edward and Mary. Indeed, it seems as if the religious scruples of musicians had been considerably diminished by the severity with which Testwood had been treated in the time of Henry VIII., and the peril into which Marbeck's zeal for reformation had involved him. For in comparing the chapel establishments of Edward, Mary, and Elizabeth, we find, that however the creeds of these monarchs differed, their musicians had constantly tuned their consciences to the court pitch: *i. e.* in perfect unison with the orders of their sovereign, the supreme head of the church.

Camden says, that "the Romish religion remained a full moneth and more after the death of queen Mary, in the same state as before." For Elizabeth, who began her reign November 17th, 1558, had a solemn service performed for her sister Mary at Westminster, December 5th, and another December 20th, for the emperor Charles V.; and these, as well as her own coronation, were celebrated in the Romish manner.

Burnet says, that "Elizabeth had been bred up from her infancy with a hatred of the Papacy, and a love to the

Reformation; but yet as her first impressions in her father's reign were in favour of such old rites as he had still retained; so in her own nature she loved state, and some magnificence, in religion as well as in every thing else."

We have no other music printed expressly for the cathedral service to English words during the reign of Edward VI. than that of Marbeck, which was mere canto fermo, without counterpoint; but the year after the publication of the English Liturgy by queen Elizabeth, the following choral work appeared: "Certaine notes set forth in foure and thre partes, to be song at the Morning Communion, and Evening Prayer, very necessarie for the Churches of Christ to be frequented and used; and unto them be added divers Godly Prayers and Psalmes, in the like forme, to the honour and praise of God. Imprinted at London, over Aldersgate, beneath St. Martins, by John Day, 1560." The authors of these compositions were Tallis, Cawston, Johnson, Oakland, Shepherd, and Taverner.

In 1565, our ecclesiastical composers, encouraged probably by the reception of the former publication, and favour of the queen, printed another collection of offices, with musical notes, under the following title: "Morning and Evening Prayer and Communion, set forth in foure partes, to be song in Churches, both for Men and Children, with divers other Godly Prayers and Anthems, of sundry Mens doyns."

The musicians who contributed to this collection were Thomas Cawston, Heath, Robert Hasleton Knight, Johnson, Tallis, Oakland, and Shepherd.

These two publications by John Day, fixed, for near a century, the style of our choral music; of which the movement was grave, the harmony grateful, and the contrivance frequently ingenious.

The great musicians of queen Elizabeth's reign were Dr. Tye, John White, Thomas Tallis, William Bird, Dr. Bull, and Thomas Morley. And these, as ecclesiastical composers, were perhaps equal in learning and genius to the greatest contemporary contrapuntists on the continent of Europe.

We must not terminate our account of the cultivation and progress of music by queen Elizabeth and her subjects, without making honourable mention of her majesty's "Virginal Book," and referring for a summary account of its contents to BIRD, WILLIAM. In all our enquiries after musical curiosities throughout Europe, we have met with no pieces so elaborate and difficult for the harpsichord, as those by our ingenious countrymen.

This book, equally valuable for its antiquity and contents, was purchased by Bremner at Dr. Pepusch's sale, 1762, whose property it was to the time of his death. After which it passed into the hands of viscount Fitzwilliams, in whose possession, we believe, it still continues.

It is a magnificent folio MS. curiously bound in red Morocco, with gilt leaves. There are nearly 70 pieces by Dr. Bull in this volume. The writing is small, but uncommonly neat, upon six lines. The compositions are in general extremely elaborate and difficult; particularly those by Bird, Dr. Bull, and Giles Farnabie, who have all contributed largely to the furnishing of this volume, which contains near three hundred pieces. The first movement in the book is an old English tune, called "Walsingham," beginning in C natural, and ending in A major, which Dr. Bull has varied in a most full and complicated style, thirty different ways. Signora Margarita, the wife of Dr. Pepusch, when she quitted the Opera stage, applied closely to the practice of the harpsichord; upon which instrument she became a great proficient. However, with all her own diligence and talents, assisted by the science and experience of

of her husband, she was never able to vanquish the difficulties of this piece, by Dr. Bull. And several of Dr. Peputch's friends and pupils, who went frequently to his apartments at the Charter-house, have assured us, that though this manuscript was constantly open upon her harpsichord desk, she never advanced to the end of the variations; as seems likewise manifest from the colour, as well as wear and tear, of the leaves, which are much more clean and entire in every other part of the book, than at the first strains of this composition.

QUEEN MARY II. joint sovereign with William III., seems to have done little more for music, than patronise Mrs. Arabella Hunt, and the old Scots tune of "Cold and raw the wind doth blow." See MARY.

QUEEN ANNE, in *Geography*, a post-town of America, in Prince George county, Maryland, situated on the W. side of Patuxent river, across which is a wooden bridge. This small town is laid out on a regular plan, at the foot of a hill. It contains a few stores, and warehouses for the inspection of tobacco; 25 miles E.N.E. of Washington.

QUEEN ANNE'S, a county of Maryland, bounded W. by Chesapeake bay, and N. by Kent county; containing 16,648 inhabitants. Its chief town is Centerville. Belonging to this county is Kent island, 14 miles long from N. to S. and $6\frac{1}{2}$ broad from E. to W. It is low, but the land is fertile, and its eastern side is bordered with salt marsh.

QUEEN CATHERINE'S *Foreland*, the northernmost point of Terra del Fuego, at the east entrance into the straits of Magellan, discovered by Frobisher in 1576.

QUEEN CHARLOTTE'S *Foreland*, the S.E. extremity of New Caledonia. N. lat. $22^{\circ} 15'$. E. long. $167^{\circ} 14'$.—Also, the S.W. point of New Hanover, in the East Indian sea, so called in 1767 by Capt. Carteret. The land about it is remarkable for a number of little hummocks, or hills. S. lat. $2^{\circ} 29'$. E. long. $148^{\circ} 27'$.

QUEEN CHARLOTTE'S *Island*, an island in the Pacific ocean, about six miles long, and one broad, discovered in the year 1767, by captain Wallis. It is described as sandy and level, full of trees, without underwood, and abounding with scurvy-grass. The canoes of this island appeared to be about 30 feet long, 4 feet broad, and $3\frac{1}{2}$ deep. The inhabitants were of a middle stature, and dark complexion, with long black hair, hanging loose over their shoulders. The men were well made, and the women handsome. Their garments were a kind of coarse matting, fastened about their middle, and capable of being brought round their shoulders. The men who landed saw no appearance of any kind of metal, but observed several tools made of shells and stones, sharpened and fitted into handles, like adzes, chisels, and awls. They saw several repositories of the dead, in which bodies were left to putrefy, under canopies, and not deposited in the ground. The island was taken possession of by captain Wallis and his crew, in the name of his Britannic majesty. They also left some hatchets, nails, glass bottles, beads, shillings, sixpences, and halfpence, as presents to the natives. S. lat. $19^{\circ} 18'$. W. long. $138^{\circ} 4'$.

QUEEN CHARLOTTE'S *Islands*, a group of islands, discovered in 1767 by Capt. Carteret, consisting of Egmont's island or New Guernsey, Lord Howe's island or New Jersey, and several others. A quarrel having occurred in consequence of the imprudent conduct of the master of Capt. Carteret's ship, between the crew and the natives, several of the latter were killed, and four of the former died in consequence of their wounds. This unfortunate event prevented any intercourse with the inhabitants of these islands. *Egmont island*, says Capt. Carteret, who called it by this name in honour of the earl, is the same with the *Santa Cruz* of the

Spaniards; and the place in which the ship had lain he called *Swallow bay*; about ten miles W. from this bay is a small island, near the coast, called *Portland's island*; and to the bay farther west, where the ship's cutter had been attacked by the Indians, he gave the name of *Bloody bay*. In this bay is a small rivulet of fresh water, and here were seen many houses, and near the water-side, one much longer than any of the rest, which seemed to be a kind of common hall, or council-house, and was neatly built and thatched. The sides and the floor of this edifice were covered with a kind of fine matting, and bundles of arrows were hung up in it ready for use. At this place there were also many fine gardens and plantations, inclosed by a fence of stone, and planted with cocoa-nut trees, bananas, plantains, yams, and other vegetables. About three miles W. of this town was another of considerable extent, in the front of which, near the water, was a breast-work of stone, about four feet six inches high, angularly formed like a fortification; from which, and from other circumstances, there is reason to believe that the natives have frequent wars among themselves. At the distance of two or three miles farther westward was found a small bight, receiving a river, which was called *Granville's river*, and westward of it is a point, to which was given the name of *Ferrari's point*. From this point the land forms a large bay, near which is a town of great extent, and apparently very populous. About seven miles W. of Ferrari's point is another, that was called *Carteret's point*, from which a reef of rocks, that appears above water, runs out to the distance of about a cable's length. To the W. of this was another large town, fronted like the last, and the people who thronged to the beach while the ship was passing, performed the same kind of circular dance with those of the former place. They were furnished with a number of canoes of different sizes. The inhabitants of Egmont island are extremely nimble, vigorous, and active, and seem as well qualified to live on the water as on the land, for they were in and out of their canoes almost every minute. With their bows and arrows they do execution at an incredible distance. Their arrows were pointed with flint, nor was there seen among them any appearance of metal. The country, in general, is woody and mountainous, intermixed with many vallies; several small rivers flow from the interior part of the country into the sea, and upon the coast there are many harbours. S. lat. $9^{\circ} 50'$ to $11^{\circ} 20'$. E. long. $163^{\circ} 30'$ to $165^{\circ} 10'$. Hawke's Voyages, vol. i. p. 349, &c.

QUEEN CHARLOTTE'S *Islands*, called by Capt. Gray, of the United States, who visited them in 1789, and by American navigators, "Washington islands," a group of islands on the N.W. coast of America. See *Queen Charlotte's Island*.

QUEEN CHARLOTTE'S *Sound*. See *Queen Charlotte's Sound*. Mr. Anderson, who visited this sound four times, has made the following remarks on the country near it. The land is every where uncommonly mountainous, rising immediately from the sea into large hills, with blunted tops. At considerable distances are vallies, or rather impressions on the sides of the hills, which are not deep, each terminating towards the sea in a small cove, with a pebbly or sandy beach, behind which are small flats, where the natives generally build their huts, at the same time landing their canoes upon the beaches. The bases of these mountains, at least towards the shore, are constituted of a brittle, yellowish sand-stone, which acquires a blueish cast, where the sea washes it. It runs, in some places, in horizontal, and, at other places, in oblique strata; being frequently divided, at small distances, by thin veins of coarse quartz. The mould, or soil, which covers this, is of a yellowish cast, not unlike marble, and is commonly

monly from a foot to two or more in thickness. The quality of this soil is best indicated by the luxuriant growth of its productions: the hills being one continued forest of trees, owing the strength of their vegetation partly to the soil, and partly also to the agreeable temperature of the climate. In February, corresponding to our August, the thermometer was not higher than 66°; and in June, corresponding to our December, the mercury never fell lower than 48°. The weather is, in general, good; but sometimes windy, with heavy rain, which, however, never lasts above a day; nor is it ever excessive. Among the trees, which covered the hills, and which are of two sorts, one supplied the place of spruce in making beer, for which purpose a strong decoction of its leaves was fermented with treacle or sugar. The other sort of tree resembled a maple, and its wood served for fuel. On the small flat spots behind there is a great variety of trees. Among other plants that were useful, may be reckoned the wild celery, which grows plentifully almost in every cove, and one that was called scurvy-grass, though very different from the plant to which we give that name. Both sorts were boiled every morning, with wheat ground in a mill, and with portable soup for the people's breakfast, and amongst their pease-soup for dinner. Sometimes they were used as salad, or dressed as greens. There is another plant, which produces a fine silky flax, of which the natives make their garments. A species of long pepper is also found in great plenty. The birds are almost entirely peculiar to the place. The principal fish caught with the seine were mullets and elephant-fish, with a few soles and flounders; but those which the natives mostly supplied were a sort of sea-bream, of a silver colour, with a black spot on the neck, large conger-eels, and a fish in shape like the bream, but so large as to weigh five, six, or seven pounds, and called "Mogge" by the natives. Of all the sorts of fish, which are here numerous, the mogge, small salmon, and colour fish, as the seamen called it, though different from ours, are superior to the rest. The rocks furnish a great variety of shell-fish. Insects are very rare. In this extensive land there are not even traces of any quadruped, excepting only a few rats, and a sort of fox-dog, which is a domestic animal with the natives. Neither is there any mineral worth notice, but a green jasper or serpent-stone, of which the New Zealanders make their tools and ornaments.

The natives do not exceed the common stature of Europeans, and, in general, are not so well made. Their colour is of different casts, from a deep black to a yellowish or olive tinge; and their features are also various, some resembling Europeans. But in general their faces are round, with their lips full, and also their noses towards the point; though the first are not uncommonly thick, nor the last flat. Their teeth are generally broad, white, and well set; and their eyes large, with a very free motion, which seems the effect of habit; their hair is black, straight, and strong; commonly cut short on the hind part, with the rest tied on the crown of the head; but some have it curling, and of a brown colour. In the young, the countenance is generally free or open; but in many of the men it has a serious cast, and sometimes a fullness or reserve, especially if they are strangers. The women are in general smaller than the men; but have few peculiar graces. The dress of both sexes is alike; and consists of an oblong garment, about five feet long and four broad, and made of the silky flax before mentioned. This seems to be their most material and complex manufacture, and is executed by knotting; and their work is often ornamented with pieces of dog-skin, or chequered at the corners. They bring two corners of this garment over their shoulders, and fasten it on the breast, with the other part

which covers the body; and about the belly it is again tied with a girdle made of mat. Sometimes they cover it with large feathers of birds, (which seem to be wrought into the piece of cloth when it is made,) or with dog-skin; and that alone sometimes worn as a covering. Over this garment many of them wear mats, which reach from their shoulders to their heels. But the most common outer covering is a quantity of sedge-plant, badly dressed, which they fasten on a string to a considerable length, and throwing it about the shoulders, let it fall down on all sides, as far as the middle of the thighs. By way of ornament, they fix in their heads feathers, or combs of bone or wood, adorned with pearl-shell, or the thin inner skin of some leaf; and in the ears both of men and women, which are pierced, or rather slit, are hung small pieces of jasper, bits of cloth, or beads, when they can get them. A few also have the septum of the nose bored in the lower part. They wear long beards, but are fond of having them shaved. Some are punctured or stained in the face, with curious spiral and other figures, of a black or deep blue colour; but it is doubtful whether this be ornamental, or intended as a mark of peculiar distinction: and the women who are marked so, have the puncture only on their lips, or a small spot on their chins. Both sexes often besmear their faces and heads with a red paint, which seems to be a martial ochre, mixed with grease; and the women sometimes wear necklaces of shark's teeth, or bunches of long beads, which seem to be made of the leg-bones of small birds, or a particular shell. They live in small coves, in companies of forty or fifty, or more; and sometimes in single families, building their huts contiguous to each other; which are in general miserable lodging places. The best was about thirty feet long, sixteen broad, and six high; built exactly in the manner of an English barn. They seemed to have no other furniture than a few small baskets or bags, in which they put their fishing-hooks and other trifles. They live chiefly by fishing, making use either of nets of different kinds, or of wooden fish-hooks, pointed with bone; but so oddly made, that a stranger would be at a loss to know how they can answer such a purpose. Their boats are well built of planks, raised upon each other, and fastened with strong withes, which also bind a long narrow piece on the outside of the seams, to prevent their leaking. Some are fifty feet long, and so broad as to be able to sail without an outrigger; but the smaller sort commonly have one; and they often, fasten two together by rafters, forming a double canoe. They carry from five to thirty men, or more; and often have a large head, ingeniously carved, and painted with a figure at the point, which seems intended to represent a man with his features distorted by rage. Their paddles are about four or five feet long, narrow, and pointed; with which, when they keep time, the boat is pushed along pretty swiftly. Their sail, which is seldom used, is made of a mat of a triangular shape, having the broadest part above. Their method of feeding corresponds with the nastiness of their persons, which often smell disagreeably, from the quantity of grease about them, and their clothes never being washed. We have seen them eat the vermin with which their heads are plentifully stocked. They also used to devour with the greatest eagerness large quantities of stinking train oil, and blubber of seals, which we were melting at the tent, and had kept near two months; and on board the ships they were not satisfied with emptying the lamps, but actually swallowed the cotton and fragrant wick with equal voracity. These people manifest as much ingenuity, both in invention and execution, as any uncivilized nations under similar circumstances. For, without the use of any metal tools, they make every thing by which they procure their subsistence, clothing, and warlike

weapons, with a degree of neatness, strength, and convenience for accomplishing their several purposes. Their chief mechanical tool is formed exactly after the manner of our adzes, and is made, as are also the chissel and goudge, of the jasper already mentioned, or of a black, smooth, and very solid stone. But their master-piece seems to be carving, which they use for various purposes, even the most trivial. Their substitute for a knife is a shell, a bit of flint or jasper : and as an auger, they fix a shark's tooth in the end of a small piece of wood. They have also a small saw made of some jagged fishes' teeth, fixed on the convex edge of a piece of wood, nicely carved : but this, they say, is only used to cut up the bodies of their enemies whom they kill in battle. No people have a quicker sense of injury done to them, and none are more ready to resent it. Their temper is suspicious and mistrustful ; and they are so dishonest, that they steal every thing upon which they can lay their hands. Such conduct may be expected, where little subordination exists, and where no man's authority seems to extend further than his own family. Their public contentions are frequent, or rather perpetual, and it appears, from their number of weapons, and dexterity in using them, that war is their principal profession. These weapons are spears, patoos, and halberts, or sometimes stones. The first are made of hard wood, pointed, from five to twenty, or even thirty feet in length. The short ones are used for throwing as darts. The "patoos," or "emeete," is of an elliptical shape, about eighteen inches long, with a handle made of wood, stone, the bones of some sea animal, or green jasper, and seems to be their principal dependence in battle. The halbert, or long club, is about five or six feet long, tapering at one end with a carved head, and at the other broad or flat, with sharp edges. Before they begin the onset, they join in a war-song, to which they all keep the exactest time, and some raise their passion to a degree of frantic fury, attended with the most horrid distortion of their eyes, mouths, and tongues, to strike terror into their enemies : which, to those who have not been accustomed to such a practice, makes them appear more like demons than men, and would almost chill the boldest with fear. To this succeeds a circumstance, almost foretold in their fierce demeanour, horrid, cruel, and disgraceful to human nature ; which is, cutting in pieces, even before they are perfectly dead, the bodies of their enemies, and, after dressing them on a fire, devouring the flesh, not only without reluctance, but with peculiar satisfaction. And yet these savages lament the loss of their friends, with a violence of expression, which indicates the most tender remembrance of them. The children are initiated, at a very early age, into all the practices, good and bad, of their fathers. They not only join in the war-song, but they likewise sing, with some degree of melody, the traditions of their forefathers, their actions in war, and other indifferent subjects ; of all which they are immoderately fond, and spend much of their time in these amusements, and in playing on a sort of flute. Their language is far from being harsh or disagreeable, though the pronunciation is frequently guttural ; and whatever qualities are requisite in any other language to make it musical, certainly obtain to a considerable degree here, if we may judge from the melody of some sorts of their songs. It is also sufficiently comprehensive, though, in many respects, deficient, if compared with our European languages, which owe their perfection to long improvement. Mr. Anderson has given a specimen of it. (Cook's Third Voyag., vol. i.) In the year 1770 Capt. Cook left among the inhabitants a boar and two fows, with some vegetables for cultivation. In 1773 he saw one of the fows, and understood that the other and the boar were both living. The

sheep and goats did not succeed ; the latter having been killed by one of the natives, and the rain having run into the sea.

QUEEN'S, the middle county of Long island, New York, about 30 miles long, and 12 broad, containing six townships, and 19,336 inhabitants. Jamaica, Newtown, Hempstead, in which is a handsome court-house, and Oyster bay, are the principal towns in this county.

QUEEN'S, a county of Nova Scotia, comprehending a part of the lands on the cape, on the S. side of the bay of Fundy. The settlements are as follow ; viz. Argyle, on the S. side of the bay of Fundy, where a few Scots and Arcadians reside : next to this is Yarmouth, settled chiefly by emigrants from New England ; Barrington, within the island, called cape Sable, settled originally by Quakers from Nantucket. Besides these are Port Raifoir, so called by the French, and originally settled by the North Irish ; Liverpool and Roseway, settled and inhabited by emigrants from New England.

QUEEN'S County, a county of Ireland, established in the reign of the first Mary, which comprehended the old district of Leix. Both the county and chief town, Maryborough, received their names in compliment to the sovereign. It is situated on the S.W. of Kildare, from which it is partly divided by the river Barrow, and is of a very compact form, being 25 Irish (nearly 32 English) miles in length, and as many in breadth. The superficial contents are about 235,300 acres, or 367 square miles, equal to 378,023 acres, or about 590 square miles English. There are 50 parishes, 26 only of which have churches, and a population of 82,000 according to Dr. Beaufort, and about 90,000 as the medium of various calculations. The high and steep mountains of Sliebh-bloom (called also Ard-na-Erin, which in the Irish language signifies the height of Ireland) form so impracticable a barrier between the King's and Queen's counties, that in a range of fourteen miles they afford but one, and that a very difficult and narrow pass into the King's county, called the "Gap of Glandine." In this great ridge are the sources of the Barrow and the Nore ; the Barrow running N.E. to Monasterevan, where it changes its direction to the S., and the Nore crossing the Queen's county by a southern course into Kilkenny. The Dyfart hills in the eastern division are conspicuous and picturesque, standing rather singly than connected. From these eminences, through the vistas formed by their particular situation, is commanded the view of a fine and beautiful country, highly adorned with rich plantations and magnificent demesnes. The rest of the county is rather flat, but lies high. The whole is watered with rivers and numerous mountain streams, and according to sir Charles Coote, its superficial appropriations may be thus estimated.

	Acres.
Arable lands, pasture, and meadow	210,000
Woods and plantations	1,300
Water	1,000
Bog, mountain, and waste	21,000
Roads	2,000
	235,300

The map belonging to the grand jury, reckons 244,938 acres, and of these 60,000 bog and mountain.

Almost every description of soil is found in this county, and it varies from a very stiff clay to a sandy loam, which, though light, is yet fertile ; a strong gravelly soil, very favourable to corn, is also prevalent. Lime-stone is so common, that there are rich quarries of it in almost every townland. The soil

foil of the Sliebh-bloom mountains is variable, the surface inclining to a black and alternately yellow stiff clay, of unequal depths, covering a loose, rotten rock, or a gritty gravel, with occasionally a little appearance of lime-stone. The western side, more generally, inclines to a strong red clay, not unlike the nature of the foil in some of the northern counties in Ireland, where oats and potatoes only are sown; but it generally is, throughout, spongy, wet, and boggy to the summit, and very rocky. Through the whole of the county, except in the south-eastern corner, near Carlow, where the collieries are extensive, bog is well interspersed, and is the general fuel. The depth of these bogs is various, and in some parts undiscovered, the best fuel lying in some a few spades depth below the surface, in others very deep. The moors are a shallow bog, with a stratum of gravel or clay, under one or two spades depth; this particular kind is easily reclaimed, and becomes the best and surest land in the county, and the cost is here but trifling, indeed often repaid in one year, having all the materials within themselves.

Amongst the mineral productions of this county, Mr Charles Coote, the author of the Statistical Survey, enumerates "coal, iron, copper, manganese, mica, lime-stone, marble, free-stone, ochre, marl, fuller's-earth, and a great variety of clays valuable in every branch of pottery." Such an enumeration is of little use; being recommended neither by detail of facts and places, nor by accuracy of information. The coal district is in another part of the same work more fully noticed; but the reader who wishes for information, is more likely to find it in the report of Mr. Griffith, mining engineer of the Dublin Society, which is shortly to be published. The coal is of that description called *stone coal*, the *glance-coal* of Jamieson, and best known by the name of Kilkenny coal. The Queen's county collieries seem to have laboured under many disadvantages, from want of capital or of proper exertion; but a prospect is opening upon us of more attention to this source of wealth. There is a very small quantity of old timber in the Queen's county. There are, indeed, leases still in existence, by which the tenant was obliged to cut, burn, or destroy so many acres of wood, to clear the land for the plough; a system which, if necessary to the establishment of order in the county, was the cause of reducing it to the bare state with respect to timber, with which the English traveller is so often struck. The Barrow and the Nore are the principal rivers which water this county. The latter is not navigable, though, being a fine deep and spacious river, it might be easily rendered so, by levelling the numerous weirs, that are of great detriment to the adjoining lands, and throw up a considerable quantity of back water.

The Barrow is navigable throughout from Portarlinton, near which it beautifully expands and winds through extensive and fertile banks. There are no lakes which deserve notice. Maryborough is the county town, near which, as well as Mountmelick and Mountrath, there was a considerable woollen manufacture of stuffs, &c. which has declined. For any particulars respecting the towns, the reader is referred to the respective articles. Besides those mentioned, Portarlinton is a place of some importance, and Stradbally a neat town. The county is represented in parliament by two knights of the shire, and by one member for the borough of Portarlinton. Maryborough and Ballynekill were disfranchised at the union. Sir C. Coote's Statistical Survey. Beaufort's Memoir.

QUEEN'S *Creek*, a river of America, in North Carolina, which runs into the Atlantic, N. lat. 34° 37'. W. long. 77° 28'.

QUEEN'S *River*, a river of the island of Dominica, which runs into the sea near Roseau.

QUEEN-*Bee*, a term given by late writers to what used to be called the *king-bee*, or king of the bees; a large and long-bodied bee, of which kind there is only one found in every swarm, and which is always treated with the greatest respect by the rest.

It is well known that the generation and whole economy of bees principally depend upon this female sovereign, and that her presence is absolutely necessary to the prosperity and safety of the whole community; inasmuch that the loss of the queen proves the certain and total destruction of the swarm or hive, unless the owner supplies them in time with another ruler. Without her presence and direction, the other bees will do no manner of work; they will gather neither wax, nor honey, nor any other materials; nor can they breed and propagate their kind without her. A flock deprived of its queen, would yield to robbers, or else languish and pine away, so that the whole society would perish. But as soon as a languishing flock is supplied with a queen, pleasure and activity are apparent through the whole hive; the presence of the sovereign restores vigour and exertion, and her voice commands universal respect and obedience: of such importance is the queen to the existence and prosperity of the other members of this community. As the parent and sovereign of every swarm is a female, the whole government is vested in one; so that where there happen to be more, as there sometimes are, and especially in swarms that are united, confusion and discord prevail, until all, except one, are expelled and slain.

As in forming artificial swarms, and for other purposes, it will be necessary to distinguish the queen from the other bees, we shall observe, that she may be known by her size, which is much larger than that of the common working-bees, and longer than that of the drones; by the form and shape of her body, especially of the hinder part of it, which is more taper, and terminates in a much sharper point than the bodies of the other bees, in order the more readily to reach the bottom of the cells, where the eggs are deposited for the propagation of the species (see *Generation of BEES*): and also by her colour; her upper parts being scarcely at all different in this respect from the honey-bees, but her belly and legs are of a very deep yellow, resembling the purest and the richest gold. It is said that she may also be distinguished by the note of her voice, which is an octave; and by her being one of the last which falls with her belly upwards, when the bees of a single flock are dropped into an empty hive, in order to be united with those of another flock.

Naturalists have observed, that the queen-bees are produced in a manner peculiar to themselves, and different from the drones and working-bees. Some have supposed that the eggs laid by the queen in a hive, and destined for the production of queen-bees, are of a peculiar kind; but though this is not the case, as M. Schirach has lately discovered, yet there are particular cells appropriated for this purpose. These cells are generally near the edges, and at the bottom of the combs, and sometimes on the sides of a honey-comb; they are of an oblong orbicular form, and very strong; and are more or less numerous in different hives, as occasion seems to require. It has been also supposed, that the matter of which they are nourished is of a different kind and quality from that employed for the nourishment of the other bees; that which has been collected out of the royal cells being of a gunny glutinous nature, of a deep transparent red, and dissolving in the fire rather than crumbling to powder.

It has been generally supposed, that the queen-bee is the only female contained in the hive; that the drones are the males by which she is fecundated; and that the working-bees are neutral, or of neither sex. But M. Schirach has lately established a different doctrine, which has been also confirmed by the later observations of Mr. Debraw. According to this writer, all the working or common bees are females in disguise; and the queen-bee lays only two kinds of eggs, *viz.* those which are to produce the drones, and those from which the working-bees are to proceed; and from any one or more of these, one or more queens may be produced; so that every worm of the latter or common kind, which has been hatched about three days, is capable, under certain circumstances, of becoming the queen, or mother of a hive. In proof of this doctrine, new and singular as it may seem, he alleges a number of satisfactory and decisive experiments, which have been since verified by those of Mr. Debraw. For the proof of this doctrine by Schirach and Debraw, and the objections of Mr. Hunter, we refer to the article *Generation of BEES*.

From this doctrine we may justly infer, that the kingdom of the bees is not, if the expression may be used, a *jure divino*, or hereditary monarchy, but an elective kingdom; in which the choice of their future ruler is made by the body of the people, while she is yet in the cradle, or in embryo; and who are determined by motives of preference which will perhaps for ever elude the penetration of the most sagacious naturalists.

The conclusions drawn by M. Schirach, from experiments of the preceding kind, very often repeated by himself and others with the same success, are, that all the common or working bees were originally of the female sex; but that when they have undergone their last metamorphosis, they are condemned to a state of perpetual virginity, and the organs of generation are obliterated; merely because they have not been lodged, fed, and brought up in a particular manner, while they were in the worm state. He supposes, that the worm designed by the community to be a queen, or mother, owes its metamorphosis into a queen, partly to the extraordinary size of its cell, and its peculiar position in it; but principally to a certain appropriate nourishment found there and carefully administered to it by the working bees, while it was in the worm state; by which, and possibly other means unknown, the development and extension of the germ of the female organs, previously existing in the embryo, is effected; and those differences in its form and size are produced, which afterwards so remarkably distinguish it from the common working bees. Schirach's *Histoire Nat. de la Reine des Abeilles*, &c. 8vo. 1772. Or, for an abstract, *Monthly Review*, vol. xlviii. p. 564, &c. *Phil. Trans.* vol. lxvii. part i. p. 29, &c. See *Generation and Sex of BEES*.

This discovery is capable of being applied towards forming artificial swarms, or new colonies of bees, by which means the number of these useful insects might be increased, and their produce in honey and wax proportionably augmented. M. Schirach, as well as M. Haistorff, seem, however, to have been mistaken, when they assert, that the artificial queens, formed and reared in a community consisting only of working bees, proceed almost immediately to lay eggs, and to people the hive, without having had any communications with the drones, and at a time when, as they suppose, there were no drones in being. It is not necessary to admit the idea of the prolific quality of a virgin queen-bee; as nature has provided drones of different sizes, for the purpose of impregnating the eggs laid by the female, and continuing the species, adapted to different occasions and circumstances. See *DRONE*.

QUEEN's Bench. See *KING's Bench*, &c.

QUEEN's Gilliflower, or *Violet*, in *Botany*. See *HESPERIS*.

QUEEN Gold, *aurum regina*, an ancient royal revenue, belonging to the queen of England, during her marriage to the king; and payable by divers persons (upon several grants of the king) by way of oblation out of fines, amounting to ten marks, or upwards; *viz.* one full tenth part above the entire fine, or ten pounds for every hundred pounds fine, on pardons and contracts or agreements.

This becomes a real debt to the queen, by the name of *aurum regina*, upon the party's bare agreement with the king for a fine, and recording it without any farther promise, or contract, for this tenth part extraordinary.

QUEEN of the Meadows, in *Botany*. See *SPIRÆA*.

QUEEN's Ware. See *POTTERY*.

QUEEN's Theatre in the Haymarket, now the Opera-house, was built in queen Anne's time by sir John Vanburgh, and not finished till the summer of 1705, at which time there were only two theatres open; Drury Lane, and Lincoln's-Inn-Fields. Betterton, who was at the head of the Lincoln's-Inn-Fields company, removed to the new theatre in the Haymarket, April 9th, 1705; when it was opened with a new prologue, written by sir Samuel Garth, and spoken by Mrs. Bracegirdle. The play was Dryden's "Indian Emperor," with singing by the Italian boy. April 23d, "The Merry Wives of Windsor," Falstaff by Betterton, with dancing by Mad. de la Val. And on the 24th, a new farce called "The Consultation;" after which was performed an Indian pastoral, called the "Loves of Ergasto," set to music by Giacomo Greber, the German musician, who had brought over from Italy Margarita de l'Epine; the part of Licoris by the Italian boy. And this was the first attempt at dramatic music in the Opera-house. The company continued acting plays here till the end of June, when there were three representations of "Love for Love," acted all by women. July 20th, according to the Daily Courant, Betterton and his company returned to the theatre in Lincoln's-Inn-Fields, where they continued to act till the Queen's theatre was entirely finished. We are the more minute about the performances in this theatre, as Cibber's account, which has been generally followed by others, is very inaccurate. October 30th, Betterton and his company quitted Lincoln's-Inn-Fields a second time, and returning to the Haymarket, opened that theatre, not with an opera, but with sir John Vanburgh's comedy of the "Confederacy," which was now acted for the first time. This excellent comedy, though the parts were very strongly cast (Leigh, Dogget, and Booth, being among the men, and Mrs. Barry, Mrs. Porter, and Mrs. Bracegirdle, among the women,) ran but six nights successively, though the performance of M. des Barques, a dancer just arrived from France, was added to the entertainment. It was, indeed, repeated once in November, and twice in December, this year; but it was generally found necessary, even in a new theatre, and with so strong a company, to fortify the best plays with dances or music, and often with both. Sometimes there was singing in Italian and English, by signora Maria, as lately taught by signor N. Haym: and sometimes music composed by signor Bononcini, and songs by signora Lovicini, &c. Daily Courant.

QUEENBOROUGH, in *Geography*, a borough and market-town in the liberty of the isle of Shepey, lathe of Scray, and county of Kent, England, is situated about three miles south from Sheerness, and forty-five east by south from London. It was anciently called Cyningburgh, from be-
longing

longing to the Saxon kings, who had a castle here, near the western entrance of the Swale, which, after the conquest, was denominated the castle of Shepey. This fortress being totally demolished in the reign of Edward III., that monarch commenced, in 1360, a more extensive and magnificent one, which was finished in the period of six years, under the superintendence of the celebrated William of Wykeham, afterwards bishop of Winchester. When the castle was completed, Edward came and resided in it several days, during which time he constituted the then village a free borough, and ordered it to be called Queenborough, in honour of his consort Philippa of Hainault. By the charter of incorporation, which bears date in 1366, he conferred sundry privileges upon the burgesses, and empowered them to elect a mayor, two bailiffs, four jurats, a town serjeant, and a water bailiff, who were to take their oath of allegiance before the constable of the castle, and to act as justices of the peace within the liberty of the corporation. This charter was confirmed, with additional privileges, by king Charles I.

Queenborough consists chiefly of one street, which is very wide, and is formed mostly of modern buildings. According to the parliamentary returns of 1811, the borough, which coincides in extent with the parish, contains 163 houses and 805 inhabitants, who are principally fishermen and oyster dredgers. The market days are Monday and Thursday weekly, and there is a well-attended fair on the 5th of August. This town sends two members to parliament, who are elected by the mayor, jurats, bailiffs, and burgesses, about 150 in number, though by the last decision of the house of commons in 1729, the elective franchise was declared to reside only in the mayor, jurats, and common council. The mayor is the returning officer, and the patronage is in the admiralty and board of ordnance.

Of the castle built by king Edward, no traces remain except the moat by which it was surrounded, and a well, by which it was supplied with water, as the town still is. Though a large and massive structure, and erected, as the letters patent express it, "for the strength of the realm, and for the refuge of the inhabitants of this isle," it does not appear to have ever been of any particular use, at least it is never mentioned in history as having been besieged, or occupied as an important military post. It was nevertheless several times repaired; first by Richard II., and again in the time of Henry VIII. Queen Elizabeth also seems to have contributed to its preservation and embellishment, as her arms were displayed on the ceiling of the great hall, surrounded by those of the nobility, and principal gentry of the county, with the date 1593, affixed to some panegyrical verses in honour of that princess. The church here was originally built as a chapel to Minster, a village situated about two miles from the town, and deriving its name from the mintre, or nunnery founded there by Sexburga, widow of Ercombert, king of Kent, about the year 673. That princess placed seventy-seven nuns in her new institution, and took upon herself the office of abbess; which she afterwards resigned to her daughter Ermenilda, and retired to Ely, where her sister Etheldred presided. During the incursions of the Danes, this nunnery was deserted and nearly destroyed; but when their invasions ceased, it was again tenanted by a few nuns, and continued to exist, though in a very mean state, till the year 1130, when the buildings were re-edified by Corbel, archbishop of Canterbury, and filled with nuns of the order of St. Benedict. At the dissolution their number was limited to a prioress and ten nuns, whose estates were estimated at 129*l.* 7*s.* 10½*d.* annual rent. These, with the site of the suppressed monastery, were then granted to sir Thomas Cheyney, lord warden

and treasurer of the household to king Henry VIII. Of the buildings, a gate-house, and part of the church, are the only remains. The latter consists of two aisles, a chancel, and a neat chapel, with the lower division of a square tower at the west end. In conformity with the date of its erection, some of the arches are semicircular in form, but most of them are in the early pointed style. In the south wall of the chancel, under a range of cinquefoil arches, is the effigy of a knight templar, said to represent and commemorate sir Robert de Shurland, lord of Shurland, who was created a knight banneret by Edward I., for his gallant conduct at the siege of Carlaverock, in Scotland. Behind the figure, towards the back of the recess, is the representation of a horse's head in the act of swimming, which has given rise to much enquiry among antiquaries, and to many fabulous and superstitious stories among the vulgar. On the pavement are several brasses of knights and their ladies; and under the arch separating the chancel from the chapel, is a gorgeous altar-tomb in honour of sir Thomas Cheyney, above-mentioned. Another altar-tomb, near it, bears the recumbent figure of a Spanish general, or admiral taken prisoner by sir Francis Drake, on the defeat of the "Invincible Armada." From an entry in the parish register, he appears to have died on board a ship at the Nore in 1591. *Beauties of England and Wales*, vol. vii. by E. W. Brayley.

QUEENSBURY, a township of America, in Washington county, New York, bounded easterly by Westfield and Kingbury; 35 miles N.E. of Albany.

QUEENSFERRY, SOUTH, a royal burgh and sea-port town in the county of Linlithgow, Scotland, is situated on the southern shore of the Firth of Forth, at the distance of nine miles W.N.W. from Edinburgh, on the great road to the north. It is first mentioned in the charters of king Malcolm IV. by the designation of "Passagium Reginar," as is generally supposed from the frequent use of the ferry here by his great grandmother Margaret, queen to Malcolm Canmore, a princess highly celebrated in Scottish history for her charitable and beneficent qualities. At that period, however, it was only a village and port, endowed with some trifling privileges: indeed, its constitution as a royal burgh did not take place till about the year 1556, when its elevation to that rank was strenuously opposed by the corporation of Linlithgow. It is now governed by a provost, one land baillie, two sea baillies, a dean of guild, and a town council, who, like most other counsellors in royal boroughs, are self-elected. Formerly this port enjoyed a considerable trade, and even so late as the year 1640, it was frequented by above twenty ships belonging to resident owners; but its traffic is at present confined to the importation of coal, for the consumption of the inhabitants, and of the materials used in the manufacture of brown soap, which, with the fishery and the business of the ferry, constitute the chief support of the town. The harbour is in good repair, and is frequently resorted to as a place of retreat in hard gales, by the smaller vessels navigating the Forth. The passage here does not exceed two miles in breadth, and, except in very boisterous weather, may be crossed at all times with safety and expedition. Much obscurity prevails relative to the founding of this ferry. The right of it is private property, and seems originally to have been attached to the lands of Murie Hall, which lie in the vicinity of the town, and are traditionally said to have been appropriated for "upholding the passage." The present proprietors are several gentlemen possessing land on either side of the Forth, who let the passage yearly by public auction. As all the northern mails, and most carriage travellers, pass at this ferry, the intercourse between its shores is constant and regular. Cattle also are transported

ported over in great numbers, as well as carts and waggons; but the difficulty and danger of effecting these objects, have induced cattle-drivers and carriers to go round by the bridge at Stirling.

The parish of Queensferry is of small extent, being confined entirely to the royalty. In ecclesiastical matters it forms part of the presbytery of Linlithgow, and synod of Lothian and Tweeddale; and, according to the population returns of 1811, contains 77 houses and 558 inhabitants.

On the summit of the ridge rising from the shore here, stands Hopetoun-house, the seat of the earl of Hopetoun, which is perhaps equal in magnificence of aspect to any palace or residence in Great Britain. The mansion is seated on a noble lawn, forming a kind of terrace along the Forth for more than a mile in front, and only terminated by the Frith, which winds round it, and appears like a wide and extensive lake, interspersed with islands and enlivened with a variety of shipping. Behind the house the ground is more various, breaking into hills, vallies, and promontories, which shoot into the Forth. All the grounds, to a considerable distance, are planted and adorned; and the house is judiciously flanked with a thick wood, to protect it against the violence of the northern winds. On this side the Forth assumes, at different points, different appearances, sometimes putting on the semblance of a lake, and sometimes that of a river. The house is a very noble display of architectural magnificence. It was begun by the celebrated architect sir William Bruce, and finished by Mr. Adam, who is believed to have added the wings. It is much to be regretted, that the interior of this princely mansion does not correspond with the grand scale of the exterior, in the size and decorations of the apartments. Beauties of Scotland by Robert Forbyth, vol. iii. Carlisle's Topographical Dictionary of Scotland, 4to. 1813.

QUEENSFERRY, *North*, a small sea-port town in the district and parish of Dunfermline, Scotland, is situated on the northern shore of the Frith of Forth, opposite to the royal burgh of South Queensferry, described in the preceding article. The principal export is whin-stone for paving, which is found in vast abundance in the extensive "whin-stone quarries" adjoining. Of that material a large proportion is conveyed to London, and many towns on the eastern coast of England. A hamlet, called St. Margaret, between this village and the head-land, which forms the western boundary of Inverkiething bay, is noted as the landing place of prince Edgar Atheling, and his sister Margaret, afterwards queen of Scotland, when they fled from England to avoid the effects of the conqueror's jealousy of Edgar's claim to the English crown. By an act of parliament, lately passed, the ferry has been placed under excellent regulations; and the harbour on each side, but particularly on the north side, has been much enlarged and improved. A signal house here contains apartments for the accommodation of the trustees, the superintendent, and boatmen. Carlisle's Topographical Dictionary of Scotland, 4to. 1813.

QUEEN'S-HOPE, or EAST-HOPE, a town in the parish of Efstyn, or Hope, cwmwd of Merffordd, cantref of Uwch, Nant, (now called the hundred of Mold,) and county of Flint, North Wales, is situated near the river Alun, at the distance of six miles N.W. from Wrexham. Together with the adjoining castle and hamlet of Caer-Gwrle, it constitutes a burgh, both by prescription, and in virtue of a charter granted by Edward the Black Prince in 1351. That deed orders that the constable of the castle shall be mayor, *ex officio*, and shall nominate two bailiffs, to govern under him,

from among the burgesses. This place obtained the appellation of Queen's-Hope, after the year 1282, from the circumstance of its having been then bestowed by Edward I. on his beloved and heroic consort Eleanor; or, as some affirm, from her majesty having lodged here, when on her way to Caernarvon to give the Welsh a ruler born within their own territories. The etymology of its ancient name, "Caer-gawr-ile," (the camp of the gigantic legion,) seems to indicate that it was once occupied by the Romans; and in confirmation of this conjecture we may observe, that a Roman hypocaust has lately been discovered here, some of the tiles used in the construction of which were inscribed "Legio XX." Pennant supposes that it was an outpost to the grand station Deva, and notices the remains of two roads. The ruins of the castle of Caer-gwrle are seated on a lofty rock isolated from the surrounding land, and, on one side, extremely precipitous. At what time, or by whom it was originally built, is unknown; but in the reign of Owen Gwynedd, it formed part of the possessions of a chieftain named Gryffydd Maelor. Edward I. made a grant of it to prince David, and afterwards, as above-mentioned, to queen Eleanor, at whose death both castle and manor were given to John de Cromwell, on condition that he repaired the former, which had been set fire to, and considerably damaged, as was supposed by design, while the king and queen were resident in it. All that remains of this once magnificent fortress, are a circular tower, and a few fragments of walls, together with the deep fosse, by which it was defended. This fosse is excavated from the solid rock, which is composed of breccia, or an excessively coarse grit.

The conjoint borough of Queen's-Hope and Caer-gwrle, is contributory with the town of Flint in the election of a representative to the British parliament. It formerly had the privileges of a market and fairs, but these are now discontinued. The parish is divided into two districts, called Hope and Kinnerton, and contains, according to the parliamentary returns of 1811, 547 houses and 2617 inhabitants. Of these a large proportion reside in the town, which consists of three broad parallel streets, intersected at right angles by three others of less breadth, the whole placed on the side of a rising ground, gently sloping to the river. The principal building is the church, which contains two mural monuments, one decorated with kneeling figures, but without any inscription; and the other commemorating sir John Trevor, knt. secretary to the earl of Nottingham, the conqueror of the boasted invincible armada.

Some objects in the vicinity of the place claim notice. On a hill, opposite to that of Caer-gwrle, is the British encampment of Caer-Efstyn, which is formed by a single ditch and rampart. The adjacent summits consist chiefly of limestone, and display on their surface numerous organic examples of the fossil remains called entrochi and alstroites. The uncommon species of the latter, usually denominated the arborecent sea-star, has been found here. At Rhyddyn are two springs strongly impregnated with muriate of soda, the waters of which are found highly serviceable in such chronic disorders as elephantiasis and scrophula. At this place is a fine old bridge over the river Alun. On the road to Mould, about two miles from Queen's-Hope, is Plas-Teg, the seat of the Trevor family. The house is a very noble building, and is generally believed to have been the work of Inigo Jones. Beyond this is Harts-Heath Hall, the property of Guillwn Lloyd Wardle, esq. It is a large modern mansion, forming a square, with three fronts, and is surrounded by fine plantations. Carlisle's Topographical Dictionary of Wales, 4to. 1812. Pennant's Tour in Wales.

QUEENSTADT, a town of Westphalia, in the principality of Halberstadt; three miles N.E. of Halberstadt.

QUEENSTOWN, a post-town of America, in Queen Anne's county, Maryland, on the E. side of Chester river; six miles S.W. of Centerville, and 65 from Washington.

QUEENSTOWN, a town or village of Upper Canada, which lies on the W. side of the straits of Niagara, near fort Niagara, and seven miles below the Falls. It is at the head of navigation for ships; and the portage occasioned by the Falls of Niagara commences here. From the sudden change in the face of the country in the neighbourhood of Queenstown, and the equally sudden change in the river with respect to its breadth, depth, and current, it has been conjectured, that the great falls of the river must originally have been situated at the spot where the waves are so abruptly contracted between the hills; and moreover it is a fact well ascertained, that the falls have receded very considerably since they were first visited by Europeans, and that they are still receding every year. See Weld's Travels, vol. ii. p. 130.

QUEE-SAN ISLANDS. See CHUSAN.

QUE ESTATE, in Law, a plea whereby a man entitling himself to land, &c. faith, that the same estate which another had, he now has from him.

Thus, *e. gr.* the plaintiff alleges that such four persons were seized of lands whereunto the advowson in question belonged in fee, and who did present it; and that afterwards the church was vacant; *que estate, i. e. which estate* he now has; and, by virtue thereof, he presents, &c. See PRESCRIPTION.

QUE EST MEME, a term used in actions of trespass, &c. for a direct justification of the very act complained of by the plaintiff as a wrong.

Thus, in an action upon the case, the plaintiff saying the lord threatened his tenants at will in such sort, as he forced them to give up their lands; the lord in his defence pleads, that he said to them if they would not depart, he would sue them at law. *Que est meme, i. e.* this being the same threatening that he used, the defence is good.

QUEGASCA HARBOUR, in Geography, a bay on the S. coast of Labrador. N. lat. $50^{\circ} 7'$. W. long. $61^{\circ} 22'$.

QUEI, in Natural History, a name given by the Chinese to a peculiar earth found in many parts of the East.

It is of the nature of an indurated clay, and in some degree approaches to the talcs, as our steatites and the galactites do. It is very white and absterfivc, used by the women of China, to take off spots from the skin, and render it soft and smooth, as the Italian ladies use tale of Venice. They sometimes use the fine powder of this stone dry, rubbing it on the hands and face after washing; sometimes they mix it with pomatum.

QUEICH, in Geography, a river of France, which passes by Landau, and runs into the Rhine, near Germerheim.

QUEI-CHUN, a city of China, of the second rank, in the province of Quang-si. N. lat. $23^{\circ} 22'$. E. long. $106^{\circ} 44'$.

QUEIGE, a town of France, in the department of Mont Blanc; four miles N.E. of Conflans.

QUEIGNE, a town of Africa, in the kingdom of Bambouk.

QUEI-LING, a city of China, and capital of the province of Quang-si, derives its name from a flower called "quei," which grows on a tree resembling a laurel; it exhales so sweet and agreeable an odour, that the whole country around is perfumed with it. This city is situated on the banks of a river, which throws itself into the Ta-ho; but it flows with such rapidity, and amidst narrow vallies, that

it is neither navigable nor of any utility to commerce. Quei-ling is a large city, and the whole of it is built almost after the model of our ancient fortresses; but it is much inferior to most of the capitals of the other provinces. Birds are found in great numbers in the territories belonging to it, the colours of which are so bright and variegated, that the artists of this country, in order to give additional lustre to their silks, interweave with them some of their feathers, which have a splendour and beauty that cannot be imitated. Quei-ling has under its jurisdiction two cities of the second class, and seven of the third. N. lat. $25^{\circ} 12'$. E. long. $109^{\circ} 51'$.

QUEIOS, a river of Spain, in Navarre, which runs into the Ebro, near Tudella.

QUEIRA, a town of Africa, in Ludamar; eight miles S. of Benowm.

QUEIS, a river of Silesia, which rises in the principality of Jauer, passes by Friedberg, Grieffenberg, &c. and joins the Bober, between Sprottau and Sagan.

QUEI-TE, a city of China, of the second rank, in Quang-si. N. lat. $23^{\circ} 18'$. E. long. $107^{\circ} 4'$.

QUELAINES, a town of France, in the department of the Mayenne; eight miles S. of Laval.

QUELEA, in Ornithology, a species of *Emberiza*; which see.

QUELINES, in Geography, mountains of Mexico, between the provinces of Guaxaca and Chiapa.

QUELLINUS, ERASMUS, in Biography, called the Old, born at Antwerp in 1607, was a pupil of Rubens, and became a painter of history of very considerable reputation. He lived to the age of 71, and left a son John Erasmus Quellinus, who also became a painter, but who left the Flemish for the Venetian style of art, which he practised at Antwerp, his native city, till he arrived at the advanced age of 85, having been born in 1630.

QUELPAERT, in Geography, an island in the sea of Corea, on which a Dutch vessel, called the Sparrow-hawk, was wrecked in the year 1635, then subject to the king of Corea. No island presents a finer aspect; the middle of the island is occupied by a peak of about 800 toises, visible at the distance of about 18 or 20 leagues, and the land gradually slopes towards the sea, so that the habitations resemble an amphitheatre. The soil to a great height seems to be well cultivated. It belongs, however, to a people who are forbidden to hold any intercourse with strangers, and who detain in slavery unfortunate persons who are wrecked on the coasts. Some Dutchmen of the Sparrow-hawk, after a captivity of eighteen years, during which they received many ballinades, found means to take away a bark, and to cross to Japan, from which they arrived at Batavia. N. lat. of the south point $33^{\circ} 14'$. E. long. $126^{\circ} 35'$.

QUELUSIA, in Botany, a name given by Vandelli to the beautiful *Fuchsia coccinea*, now so common in gardens. The author supposed it a new genus, and meant thus to honour a royal villa near Lisbon, called *Quelus*, where he first saw this plant in bloom.

QUEM redditum reddit, in Law, an old writ which lay where a rent-charge, or other rent, which was not rent-service, was granted by fine holding of the grantor. If the tenant would not attorn, then the grantee might have had this writ.

QUEMARY, in Geography, a town of Bootan; 20 miles E. of Beyhar.

QUEMENES, a small island in the English channel, near the coast of France. N. lat. $48^{\circ} 22'$. W. long. $4^{\circ} 48'$.

QUEMI,

QUEMI, in *Botany*, a name used by some authors for the nigella, or guth.

QUEMIGNY, in *Geography*, a town of France, in the department of the Côte d'Or; nine miles S.W. of Dijon.

QUENDAL BAY, a bay at the S. extremity of the island of Shetland. N. lat. $59^{\circ} 49'$. W. long. $1^{\circ} 40'$.

QUENDON *Water-Barrow*, in *Rural Economy*, a contrivance of the barrow kind, much employed in the neighbourhood of the little village of Quendon, in Essex, and from which it takes its name, for the purpose of conveying water, wash, and other liquid matters, to live stock of different kinds, as fattening cattle, hogs, horses, and other animals, as well as for some other uses. It is a simple and excellent invention for all such intentions, as very great facility is given to its motion by means of the wheels, and it is, on the whole, very compact in its general formation, which gives it a superiority over many other contrivances of a similar nature, as being capable of being put in motion, when full, without any great difficulty, or the application of any extraordinary power or force.

It is represented at *figs. 6 and 7*, in *Plate Agriculture*, shewing the methods of clearing quarries, pits, &c. from water. *Fig. 6.* explains the plan, in which *ab, ab*, are the wheels, that fasten on to the side-beams *cd, cd*, which are about four feet in length, and have their ends *c, c*, formed in such a manner as to serve for handles. *E* is an oval tub about thirty inches in depth, twenty-four in length, and eighteen in breadth, which is supported on the beams by two gudgeons, which play in semicircular boxes fixed near the ends of the beams: a cross piece connects the two beams at *ff*, as does another at *gg*, to which two little curved pieces come, parallel to the form of the tub. The wheels are about four feet in height, and carry the tub suspended between them; for the gudgeons play almost over the two short axles, which square into the beams. Two flight legs are fixed underneath the barrow at *ii*, to keep it in an upright position, but they are not at all essential, for the tub would remain in a state of equipoise between the wheels even without such aid. It must be noticed, that the tub is sunk rather more than one-half below the gudgeons.

Fig. 7. displays the profile of the vehicle; the dotted line shews the size and place of the tub, which is made oval, for the purpose of confining the breadth between the wheels, so as to pass in at narrow door-ways, &c.

It is probable that it might be somewhat improved by having the axles hooked within, so as to bear upon two loops in one of the iron hoops, and by this means render the use of gudgeons and boxes wholly unnecessary. The tub would lift off and on, as easily as at present, while it would hang in a more precise and perfectly central manner. And still further, it would be a great convenience, if the upper part of the tub were furnished with a proper spout in the front, in order to pour water or other liquid materials through between the pales, &c. for the supplying of cattle, &c. This would be more easily accomplished, if the tub were allowed to swing in a free manner, as it might in that case be tilted up with great facility, so as to favour its being done, as shewn by the dotted line in *fig. 2.* About the little town noticed above, it is a great deal employed in carrying water for house use as well as that of farms. It is described in the *Agricultural Magazine*. Many other forms of water-barrows are made use of in different places. See *WATER-Barrow*.

QUENEG, or QUENENA, in *Geography*, a district of Africa, in the country of Sugulmesia, near mount Atlas.

QUENOY, LE, a town of France, in the department of the North; five miles N.N.W. of Lille.

QUENTIN, in *Commerce*, a small weight used in Germany; the ounce contains two lochs, or eight quentins.

QUENTIN, *St.*, in *Geography*. See ST. QUINTIN.

QUEPO, a town of Mexico, in the province of Costa Rica, on the Estrella; 70 miles S.S.W. of Carthage.

QUERA, a town of Italy, in the Trevisan; 15 miles W. of Ceneda.

QUERALOS, a town of Spain, in Catalonia; 24 miles E. of Urgel.

QUERCERA, in *Medicine*. See EPIALOS.

QUERCETO, in *Geography*, a town of Etruria; nine miles S.S.W. of Volterra.

QUERCUS, in *Botany*, the Oak, an ancient Latin name, whose etymology has been considered as very uncertain, if not quite inexplicable. So it well might seem to those who looked no further than the Greek or Latin languages; for though some have deduced the word from *χαίρος*, a pig, because pigs feed on acorns, this explanation has not proved satisfactory. De Theis, on the authority of Lepelletier, has found a much better etymology for *Quercus*, in the Celtic *quer*, fine, and *cuez*, a tree; and this appellation is supposed to have been appropriated to the oak, not only for the beauty of the tree, but because it bore the sacred plant, mistletoe. This tree was also called in the Celtic tongue *derw*, whence came the word *druid*, or priest of the oak, and even the Greek *δρυς*, an oak, vulgarly supposed the original of druid. (See DRUIDS.)—Linn. Gen. 495. Schreb. 646. Willd. Sp. Pl. v. 4. 423. Mart. Mill. Dict. v. 4. Sm. Fl. Brit. 1025. Ait. Hort. Kew. v. 5. 287. Juss. 410. Tourn. t. 349. Lamarck Illustr. t. 779. Gært. t. 37. (Ilex; Tourn. t. 350. Suber; ejusd.)—Class and order, *Monocotyledon*. Nat. Ord. *Amentaceae*, Linn. Juss.

Gen. Ch. Male, in a loose catkin. *Cal.* Perianth of one leaf, bell shaped, membranous, with about five small, sharp, often cloven segments. *Cor.* none. *Stam.* Filaments from four to ten, capillary, short; anthers large, of two round lobes.

Female, from a bud usually on the same tree, *Cal.* Perianth of one leaf, inferior, coriaceous, hemispherical, rough, entire, very small in the flower, permanent. *Cor.* none. *Pist.* Germen superior, ovate, very small; style simple, divided above into from two to five segments, longer than the calyx: stigmas simple, permanent. *Peric.* none. Seed an oval or roundish coriaceous nut, of one valve, smooth, attached by its scarred base to the bottom of the shortish, hardened, permanent, cup-like calyx.

Eff. Ch. Male, Calyx bell-shaped, membranous, lobed. Corolla none. Stamens from five to ten.

Female, Calyx bell-shaped, coriaceous, entire, rough. Corolla none. Style one. Stigmas from two to five. Nut coriaceous, embraced at the base by the hardened calyx.

This genus, so distinct in its botanical characters, and so valuable for its economical uses, consists, in the *Species Plantarum* of Linnæus, of no more than thirteen species. The discoveries of Thunberg, but especially those of American travellers, aided by the more accurate enquiries of botanists, have so greatly enriched the subject, that Willdenow, who has studied it well, enumerates seventy-six kinds of *Quercus*, and even these are not all that we have to describe. The importance of many species requires that they should all be particularized. Two or three of the East Indian ones, now for the first time described, offer some exceptions to the generic character of the calyx.

Section 1.—*Adult leaves undivided and entire.*

1. *Q. Phellos*. Deciduous Willow-leaved Oak. Linn. Sp. Pl. 1412. Willd. n. 1. Ait. n. 1. Pursh n. 1. Sm.

QUERCUS.

in Abbot's *Insects of Georgia*, v. 2. 181. t. 91. Michaux *Querc. n. 7. t. 12.* (*Q. virginiana*, *falicis longiore folio*, *fructu minimo*; Pluk. *Amalth.* 180. t. 441. f. 7.)—Leaves membranaceous, linear-lanceolate, tapering at each end, entire, smooth, with a small point. Nut roundish.—Native of North America; in low swampy forests, near the sea-coast, from New Jersey to Florida, flowering in May. *Pursh.* It is said by Mr. Aiton, on the authority of Knowlton's MSS., to have been cultivated in England by Mr. Fairchild, before the year 1723; and indeed, by the collection at Bultrode, this tree appears to have been planted there much earlier, among those introduced by the first earl of Portland. It rises in its native country, as well as in England, to the height of fifty or sixty feet. The *bark* is smooth; the *wood* is good, and much in use, but of slow growth. *Leaves* scattered, on short stalks, four or five inches long, and not an inch wide, smooth, thin and pliant, of a fine green, with a willow-like aspect, deciduous, their edges slightly wavy. *Acorns* in pairs, roundish, scarcely above half an inch long, with a thin, tuberculated, or tessellated cup. The *leaves* of the young plant are somewhat angular, or toothed at each side. There is said to be a dwarf straggling variety, with shorter *leaves*, which Catesby has figured in his vol. 1. t. 22. Michaux has two supposed varieties, which other botanists esteem distinct species; see the two following. The specific name, chosen by Linnæus, is not a good one, *φελος* being the cork-tree.

2. *Q. maritima*. Ever-green Willow-leaved Oak. Willd. n. 2. *Pursh n. 2.* (*Q. Phellos maritima*; Michaux *Querc. n. 7. var. 2. t. 13. f. 3.*)—Leaves coriaceous, elliptic-lanceolate, entire, smooth, with a small point. Nut roundish.—Found on the sea-coast of Virginia and Carolina, flowering in May and June. This differs from the foregoing in its low shrubby habit, and firm evergreen *leaves*, which are more elliptical in shape, and not above two inches long. The whole plant is from three to eight feet only in height. It appears by the accounts of authors to be distinct from the above-mentioned variety of *Phellos*.

3. *Q. sericea*. Silky Willow-leaved Oak. Willd. n. 3. *Pursh n. 3.* (*Q. Phellos*; Sm. in *Abb. Inf. v. 2. 101. t. 51.* *Q. Phellos pumila*; Michaux *Querc. n. 7. var. 3. t. 13. f. 1, 2.*)—Leaves lanceolate-oblong, somewhat wavy; obtuse at the base; rather dilated upwards; silky beneath. Nut almost globular.—Native of the sea-coast, from Carolina to Florida, flowering in May. It is perhaps the most humble of the whole genus, scarcely ever exceeding two feet in height, and throwing out creeping scyons, whence it has obtained the name of the Running Oak. The silkiness of the *leaves* beneath gives them a glaucous appearance.

4. *Q. myrtifolia*. Myrtle-leaved Oak. Willd. n. 4. *Pursh n. 4.*—"Leaves coriaceous, oblong, entire, smooth, acute at each end."—Native of Carolina, according to Willdenow, who alone has noticed this species, and from whom *Pursh* has admitted it into his work. The *branches* are round, brown. *Leaves* an inch, or rather more, in length, coriaceous, evergreen, oblong, somewhat acute at the base; entire and slightly revolute at the margin; shining above; opaque, but smooth, beneath; on short *footstalks*. The form of the *leaves* is much like the common broad-leaved myrtle. The *flowers* and *fruit* are unknown. *Willd.*

5. *Q. virens*. Live Oak. Ait. Hort. Kew. ed. 1. v. 3. 356. ed. 2. n. 2. Willd. n. 5. *Pursh n. 5.* Michaux *Querc. n. 6. t. 10, 11.* (*Q. Phellos β*; Linn. Sp. 1412. *Q. fempervirens*; Walt. Card. 234.)—Leaves coriaceous, elliptic-oblong, revolute, entire, pointless; obtuse at the base; clothed with starry down beneath. Fruit stalked. Nut oblong.—Found near the sea-coast of North America, in a

soil of sand upon clay, from Virginia to Florida and Mississippi, flowering in May. Miller cultivated it at Chelsea in 1739, but we know not that this species is still preserved, or, at least, distinguished from *Q. flex*, in our gardens or plantations. It is one of the most valuable American trees, growing to the height of forty or fifty feet, and extending its *branches*, in open situations, to a great extent; whence it serves, by its dense evergreen *leaves*, to shelter cattle from the summer's heat and winter's cold. The *wood* is the finest and most durable ship timber. It is felled towards the end of autumn, and kept three months before it is used. Michaux recommends this tree to the notice of the French and Spaniards, as likely to thrive well on the sandy coasts of the Mediterranean, and of the western ocean. By his account it succeeds best where there is a basis of clay under the sand, to fix the larger roots. The aspect of the *leaves* is not unlike our European *Q. flex*, but they are, except when very young, more uniformly entire, and more shining; their under side less densely pubescent; and their short *footstalks*, as well as the mid-rib, reddish. The foliage of seedling plants, and of vigorous young shoots, is, indeed, strongly toothed. The adult *leaves* are scarcely more than two inches long, somewhat oval, or obovate and bluntish, without any terminal bristle; silky in the spring; subsequently of a dark but shining green, and downy, with starry pubescence, beneath. The *filaments* are but four or five. *Stalks* of the fruit an inch long. *Acorn* cylindrical, an inch long, with a tessellated, but not rugged or tuberculated, cup. The acorns are said to be greedily devoured by hogs, and several wild animals; and to afford an oil, which the savages of Florida mix with their food.

6. *Q. cinerea*. Ash-coloured Silky-leaved Oak. Willd. n. 6. Ait. n. 3. *Pursh n. 6.* Michaux *Querc. n. 8. t. 14.* (*Q. humilis*; Walt. Carol. 234. *Q. Phellos β*, *sericea*; Ait. Hort. Kew. ed. 1. v. 3. 354. *Q. Phellos γ*; Linn. Sp. Pl. 1412.)—Leaves coriaceous, elliptic-lanceolate, revolute, entire, bluntish with a small point; clothed with starry down beneath. Fruit sessile. Nut nearly globose.—Native of dry barren situations, and pine forests, from Virginia to Georgia, flowering in May. Michaux says it springs up chiefly on land that, after having been cultivated, becomes abandoned on account of the bad quality of the soil. The form of the *tree* is unsightly, and its size very variable, from four to twenty feet in height. The *wood* is of no use but for firing. *Leaves* longer than in the preceding; the young ones dilated at the top, with three points. *Fruit* nearly or quite sessile, almost globular, and not much above half an inch long.

7. *Q. microphylla*. Small-leaved Dwarf Oak. Willd. n. 7. Née in *Annal. Scient. Nat. v. 3. 264.* Fisch. Misc. Hist. v. 1. 99. *Willd.*—"Leaves lanceolate, pointed, entire, villous; downy beneath. Calyx of the fruit villous. Nut roundish."—Found by Louis Née, on the hills of Arambaro, in New Spain. A *shrub*, from three to five feet high, with a rough ash-coloured bark. *Leaves* on short stalks, scattered, numerous, from four to six lines long, scarcely two lines broad, veiny, revolute, wavy, pointed, reddish-grey; villous above; densely downy beneath; those about the extremities of the branches opposite. *Stipules* awl-shaped, falling off at the close of summer. *Acorns* in axillary pairs, about the ends of the branches, ovate, the size of a large pea, half covered by the villous cup, which is invellid with unequal scales. *Née.*

8. *Q. salicifolia*. Mexican Willow Oak. Willd. n. 8. Née in *Annal. Scient. Nat. v. 3. 265.* Fisch. Misc. Hist. v. 1. 101. *Willd.*—"Leaves oblong-lanceolate, entire, smooth; the forks of the veins villous and brown beneath. Nut oblong."

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long."—Found by Lewis Nee, in the kingdom of Mexico, near Acapulco. A tree twenty-eight feet high, with alternate branches; the young ones somewhat furrowed, and clothed with brownish-red hairs. Leaves from five to seven inches long, an inch wide, scattered, on short stalks, rather coriaceous, smooth, veiny, entire, wavy, pointed; reticulated and green above; yellowish beneath, with tufts of hairs, as big as a pin's head, in the forks of the veins. Acorns nearly sessile, in axillary pairs, the size of a hazelnut, downy, half covered by the hemispherical, greyish, villous cup, beset with very thin scales. *Nee*.

9. *Q. glabra*. Smooth-leaved Japan Oak. Thunb. Jap. 175. Willd. n. 9.—"Leaves lanceolate-oblong, pointed, smooth, with parallel veins."—Gathered by Thunberg in Japan. A tree, whose branches grow two or three together, slightly spreading, rugged and knotty. Leaves alternate, stalked, lanceolate-oblong, entire, pointed, with parallel ribs (veins); tapering at the base; smooth on both sides; shining above, yellowish beneath. Spikes of flowers either solitary, or two or three together, downy. *Thunberg*.

10. *Q. concentrica*. Concentric-furrowed Oak. Loureir. Cochinch. 572. Willd. n. 10.—"Leaves lanceolate-ovate, pointed, incurved, entire. Calyx lax, very short, furrowed concentrically."—Native of the lofty forests of Cochinchina. A large tree, whose wood is serviceable for various uses. Branches ascending. Leaves scattered, stalked, smooth on both sides. Acorns stalked, oblong-ovate, smooth, red, pointed, their cups short and lax, externally marked with five parallel circular furrows; see n. 27.

11. *Q. molucca*. Molucca Oak. Linn. Sp. Pl. 1412. Willd. n. 11. Rumph. Amboin. v. 3. 85. t. 56.—Leaves elliptic-lanceolate, entire, acute at each end, smooth. Nut roundish, furrowed.—Native of the Molucca isles. A large and lofty tree, whose wood is hard and heavy, lasting long under water. Leaves six or eight inches long and three broad, on short stalks, with eight or ten irregular lateral veins. Acorns short and roundish, furrowed in their upper part; the cup short, warty. By Rumphius's account, there seem to be more species than one comprehended under the chapter above cited, but he does not give us sufficient marks to define them specifically.

12. *Q. spicata*. Cluster-fruited Oak.—Leaves elliptic-lanceolate, taper-pointed, entire, smooth. Spikes axillary, solitary, dioecious. Fruit spiked, aggregate, ovate.—Gathered by Dr. Francis Buchanan, in woods at Suembi, in Upper Nepaul, flowering in May, 1802. This is a tree of vast dimensions, whose wood is useful, though inferior in quality to that of *Q. annulata*, n. 22. The younger branches are angular, clothed with very minute green pubescence. Leaves alternate, stalked, of a broad lanceolate, or elliptical figure, with a taper point, entire throughout, six or seven inches long, and two and a half wide; bright green, smooth and shining above; paler, opaque, but scarcely pubescent, beneath; furnished with numerous, parallel, transverse veins. Footstalks not an inch long, depressed. Stipules deciduous. Flowers in long, linear, downy, pale, straight, solitary, axillary spikes; the males with about eight stamens, much longer than the calyx, and a roundish rudiment of a germen in the centre; females on a separate tree, crowded three together in sessile groups in each spike. Acorns eatable, but not very good, the size and shape of a large filbert, even, pointed, dark brown; their cups short, scaly. The original natives of Nepaul, or Nawars, know this tree by the name of *Guey Sasbi*, or *Pacushingali*: their Hindu conquerors, the Parbutties, call it *Arcaula*.

13. *Q. tribuloides*. Caltrop-fruited Oak.—Leaves ovato-

lanceolate, taper-pointed, entire, smooth. Spikes aggregate. Calyx of the fruit spinous, covering the nut.—Discovered by the same able botanist as the preceding, in the forests of Upper Nepaul, flowering and fruiting at various seasons. A tree with smooth branches. Leaves on short stalks, lanceolate, more or less ovate, somewhat unequal at the base, about four inches long, and one and a half broad, rigid and rather coriaceous, with irregular, distant, slightly curved veins; the upper surface polished; the under paler and opaque. Flowers monoecious, in slender, downy, clustered, axillary or terminal, pendulous spikes, the male spikes most numerous. Stamens about eight, with a dotted central disk. Acorns spiked, scattered, ovate, smooth, obliquely pointed, about half an inch long, entirely concealed in the greatly enlarged calyx, which is downy, globose, and armed with very numerous, rigid, prominent, sharp thorns, a quarter of an inch, or more, in length, spreading in every direction. This species is called *Cattum*, or *Cattunge*, in the Parbutty language; *Shingali*, or *Catu Shingali*, by the Nawars. Its great peculiarity consists in the acorns, which are eatable, being entirely enclosed in a strongly muricated calyx, or globose cup, which approaches the nature of the chestnut, *Fagus Castanea*, and in some of our specimens seems even to split into two or three valves. The flowers, however, agree with *Quercus*, to which genus Dr. Buchanan referred this remarkable plant. On one tree he observed the flowers to be all female.

14. *Q. laurifolia*. Laurel-leaved Oak. Willd. n. 12. Ait. n. 4. Pursh n. 8. Michaux Querc. n. 10. t. 17, 18.—Leaves obovate, entire, smooth, nearly sessile; tapering at the base. Nut roundish, even.—Native of shady forests, and the sea-coast, in Georgia and South Carolina, flowering in May. This is sometimes called the Swamp Willow, and was first brought alive to England, by the late Mr. Frazer, in 1786. It rises to the height of fifty or sixty feet. Michaux speaks of the wood as of a good quality, but inferior on the whole to that of our fifth species, *Q. virens*. The leaves are crowded about the ends of the branches, deciduous, about four inches long, usually acute, but sometimes, as in Michaux's t. 18, remarkably obtuse. Acorns solitary, nearly sessile, almost globose, with a scaly cup.

15. *Q. imbricaria*. Shingle Oak. Willd. n. 13. Ait. n. 5. Pursh n. 7. Michaux Querc. n. 9. t. 15, 16.—Leaves elliptic-oblong, acute at each end, entire, almost sessile; downy beneath. Nut nearly globose.—Native of the banks of rivers among the Allegany mountains, and in the countries to the west, rarely to the east of those mountains, flowering in May and June. Brought to England in 1786, by Mr. Frazer. The leaves are twice the size of the last, acute, but not contracted, at their base, and downy on the under side. Acorns much like the last-described. This tree is forty or fifty feet high. Its wood is chiefly used, by the French settlers in the Illinois country, for making boards to cover houses, whence the appellation of *Q. imbricaria* in Michaux, and of Shingle Oak among the English Americans. For although the scales of the cup are rather larger than those of *Q. laurifolia*, the specific name does not allude to that circumstance.

16. *Q. elliptica*. Oval-leaved Mexican Oak. Willd. n. 14. Nee in Annal. Scient. Nat. v. 3. 278. Fisch. Misc. Hist. v. 1. 117.—"Leaves elliptical, entire, coriaceous, nearly sessile; rounded at each end; roughish beneath. Gathered by Louis Nee, but without flowers or fruit, in the kingdom of Mexico, by the road from Ixmiquilpan to Cimapan, as well as between Tixtala and the river Azul. The trunk is thick, twelve feet high, with a grey bark. Branches horizontal; the smaller shoots erect; all

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all very leafy. *Leaves* three inches long, and one and a half broad, slightly revolute; smooth above; roughish and veiny beneath, the veins forked. *Footstalks* thick and very short. *Nec.*

17. *Q. acuta*. Pointed-leaved Japan Oak. Thunb. Jap. 175. Willd. n. 15.—“Leaves oblong, pointed, entire, with parallel veins; rounded at the base; downy when young.”—Observed by Thunberg in Japan. The *branches* are knotty, ash-coloured, dotted with white, smooth downy at the summit. *Leaves* alternate, stalked, smooth, when full-grown; covered at the back, when young, with rusty down. *Spikes* axillary, clothed with similar pubescence. Thunberg.

18. *Q. magnoliaefolia*. Magnolia-leaved Oak. Willd. n. 16. Née in Annal. Scient. Nat. v. 3. 268. Fisch. Misc. Hist. v. 1. 103.—“Leaves ovate-oblong, coriaceous, entire, shining; downy beneath; somewhat emarginate at the base. Fruit racemose.”—Found by Louis Née, in the kingdom of Mexico, between Chilpancingo and Tixtala, and about the river Azul. This is an elegant *tree*, twenty feet, or more, in height. *Trunk* thick, with a dark-coloured bark full of fissures. *Branches* horizontal; younger ones furrowed, and dotted with white. *Leaves* six or eight inches long, and three broad, ovate, rigid; sometimes emarginate at the base; green and shining above; downy beneath, with the larger veins prominent, and the smaller reticulated. *Footstalks* thick, a line in length. *Stipulas* crisped, downy, deciduous. Female *clusters* solitary, axillary, two inches long; the lower ones alternate, upper opposite. *Acorns* ovate, half covered by their hemispherical cup, which is the size of the seed of *Cicer arietinum*, its scales scarcely at all imbricated. *Nec.*

19. *Q. lutea*. Yellow-leaved Mexican Oak. Willd. n. 17. Née in Annal. Scient. Nat. v. 3. 269. Fisch. Misc. Hist. v. 1. 105.—“Leaves obovate, entire, shining; somewhat heart-shaped at the base; downy and yellow beneath.”—Found in Mexico by the same celebrated traveller and botanist. This agrees with the preceding in its mode of growth, and fructification, inasmuch that it may be thought a variety; yet the *leaves* are very different. They are of a larger size, broader towards the end, and contracted towards the *footstalk*, as well as more deeply emarginate at the base; and their under side is clothed with ochrey yellow pubescence.

20. *Q. semecarpifolia*. Marking-nut-leaved Oak.—Leaves obovate, obtuse, coriaceous, entire; heart-shaped at the base; glaucous beneath; the young ones with spinous teeth.—Gathered by Dr. F. Buchanan, on the banks of torrents in Upper Nepaul, where its Parbuttie appellation is *Cassur*, and its Nawar name *Ghirsi*. This is a middle-sized *tree*, with angular *branches*, clothed when young with scaly down. *Leaves* evergreen, alternate, on short thick *stalks*, obovate-oblong, four or five inches in length, and two in breadth; more or less heart-shaped at the base; their upper surface smooth and shining; the under opaque, clothed with rusty down, and furnished with numerous, irregular, rather distant, transverse, prominent veins; their margin entire, slightly wavy. The extremity is usually rounded and obtuse, sometimes abrupt, sometimes tipped with a little spine. On young *branches* the *leaves* are serrated with strong spines, or even sinuated, and clothed on both sides with rusty down. *Stipulas* in pairs, awl-shaped, erect, permanent, as long as the *footstalks*. Dr. Buchanan did not observe the *flowers* or *fruit*. The aspect of the adult *leaves* is much like those of *Semecarpus Anacardium*, or some of the entire-leaved species of *Ficus*.

Section 2.—*Leaves more or less toothed or serrated.*

21. *Q. glauca*. Glaucous-leaved Oak. Thunb. Jap.

175. Banks Ic. Kämpf. t. 17. Willd. n. 11. (Kas no ki: Kämpf. Amoen. 816.)—Leaves obovate, pointed; serrated towards the extremity; glaucous beneath. Nut roundish.—Gathered near Nagasaki, in Japan, by professor Thunberg, to whom we are obliged for a specimen. He describes it as a very large *tree*, whose *branches* are somewhat umbellate, erect, round, purple, smooth, except some prominent white points. The *leaves* are alternate, about three inches long, and near two broad, with a blunt projecting point; their upper surface smooth and polished; the under covered with a fine glaucous mealiness, and marked with prominent, straight, parallel, but rather distant, obliquely transverse veins; the margin distantly serrated upwards. *Footstalks* about half an inch long, purple. *Flowers* axillary. *Acorns*, by Kämpfer's figure, axillary, often in pairs, of a roundish tumid shape, pointed, not an inch long, their cups short, seemingly marked with concentric lines; their *stalks* simple, short and thick.

22. *Q. annulata*. Ring-cupped Oak.—Leaves obovate, pointed; serrated in their upper half; somewhat glaucous and downy beneath. Fruit spiked. Nut oblong. Calyx furrowed concentrically.—Gathered by Dr. Buchanan, at various places in Upper Nepaul, bearing fruit, in December 1802. A very large *tree*, whose wood is excellent; the *branches* two or three together, smooth. *Leaves* evergreen, rigid, exactly like those of the last species, but somewhat silky beneath, and less glaucous; the young ones very silky. *Stipulas* linear, hairy, longer than the *footstalks*, deciduous. *Male flowers* in pendulous, hairy, yellowish, shortish spikes, springing from buds below the leaves, whose scales are imbricated in five rows: *female* from three to six, in solitary, axillary, upright, stalked, smooth spikes, about the length of the *footstalks*. *Calyx* of the female flowers globose, smaller than hemispherical, composed of several concentric imbricated layers, of which the outermost is smooth and notched, the rest downy and entire. *Germen* globose. *Style* very short and thick. *Stigmas* three, obtuse. *Acorns* quite sessile on the common flower-stalk. *Cup* rather smaller than that of our British oaks, entire and even at the edge, composed of seven or eight concentric, annular, imbricated, crenate scales, externally silky. Nut ovate, acute, smooth and even, twice as long as the cup. The Parbutties call this tree *Pbullaat*; the Nawars *Gusbi*, or *Pacastringali*.

We find great reason to think that it may be, as Dr. Buchanan suspected, the same species with Thunberg's *glauca* last described. The *leaves* of his specimen shew a slight degree of pubescence about the veins, but have not the minute silkiness of our's. The greatest and most essential difference, if Kämpfer be as correct as usual, consists in the female inflorescence. He delineates the acorns of *glauca* on short, simple, axillary *stalks*, either solitary or in pairs; and Thunberg describes the *flowers* as axillary. In our plant the female *flowers* are indeed axillary, but they compose a stalked *spike*, and neither they nor the *acorns* have any partial stalks. Such differences are found between other species of Oaks, and prove essential and invariable. We therefore cannot but, for the present at least, rely on Kämpfer's known fidelity, and propose our *Q. annulata* as a distinct species.

23. *Q. lamellosa*. Many-cupped Oak.—Leaves elliptic-oblong, pointed, serrated, many-veined; glaucous and somewhat downy beneath. Calyx of many concentric entire layers, as long as the nut.—Discovered by Dr. Buchanan, in the more remote woods of Nepaul, bearing fruit in December 1802. In the Nawar language it is called *Tuppafusbi*. The *tree* is lofty, with smooth bluntly-angular *branches*. *Leaves* alternate, six inches in length and two in breadth, elliptic-

elliptic-oblong, rigid, taper-pointed, sharply serrated; smooth and green above; glaucous and often finely downy beneath, with innumerable, prominent, crowded, straight, parallel, mostly opposite, obliquely transverse veins: the aspect and size of the leaves much resembling *Dillenia indica*. *Footstalks* an inch and half long, tumid at the base. *Stipulas* deciduous. Female flowers in short axillary spikes. *Acorns* ovate, pointed, the size of chestnuts, each completely enveloped and concealed by the large, globular, downy cup, which is as big as a small apple, and consists of eight or nine distinct, concentric, entire, imbricated layers, much more deeply separated than the rings of *Q. annulata*. An approach towards the genus *Fagus*, or *Cuscuta* of some authors, may be observed, as Dr. Buchanan suggests, in this species, which is nevertheless a genuine *Quercus*, and far less doubtful than our *tribuloides*, n. 13. It proves however that the mere elongation of the acorn, beyond the cup, is not an indispensable character of the present genus. See also *tomentosa*, n. 42.

24. *Q. cuspidata*. Pointed Japan Oak. Thunb. Jap. 176. Willd. n. 19. (Sui, vulgò Sui no ki; Kämpf. Amoen. 816.) "Leaves ovate, pointed, serrated, smooth. Calyx prickly."—Native of Japan, about Nagasaki. A tree, with striated, smooth, spreading branches. Leaves alternate, stalked, an inch long, ovate, rounded at the base, pointed, smooth on both sides, with parallel veins; their upper half serrated. Female flowers scattered over the young branches, solitary, nearly sessile. Cup of the acorn prickly, the size of a hazelnut. Thunb. This species, like n. 13, appears, by its prickly cup, allied to *Fagus*; especially as Kämpfer, who calls it *Fagus folio fraxini*, describes the dry cup as splitting into three, four, or five parts. The nut is eaten by the Japanese, either raw or cooked.

25. *Q. ferrata*. Saw-leaved Japan Oak. Thunb. Jap. 176. Willd. n. 20.—"Leaves oblong, serrated, villous and downy, with parallel veins."—Native of Japan, flowering in May and June. A tree, with alternate, smooth, ash-coloured, knotty, spreading branches, besprinkled with white tubercles. Leaves alternate, pointed, all acutely and equally serrated, furnished with straight parallel veins; green above and very silky when young; paler beneath, silky and downy at first, but subsequently more slightly villous; their length from one to three inches. Male flowers in hairy, drooping, long-stalked spikes, each an inch long. Our specimen is in an early state of foliage, nor have we any account of the fruit, or female flowers.

26. *Q. dentata*. Tooth-leaved Japan Oak. Thunb. Jap. 177. Willd. n. 69. (Koku; Kämpf. Amoen. 816.)—"Leaves obovate-oblong, obtuse, deeply toothed; downy beneath."—Native of hills in Japan, flowering in April and May. A tree, with thick, erect, rugged, furrowed branches, besprinkled with dots and tubercles; downy at the summits. Leaves crowded about the extremities, on very short stalks, obovate-oblong, obtuse, with deep teeth destitute of spines; villous above; downy beneath; pliant, two inches long; their veins parallel. Thunb. Kämpfer says the wood is white.

27. *Q. lanata*. Woolly-leaved Nepaul Oak.—Leaves elliptic-oblong, sharply serrated, coriaceous; densely woolly beneath. Fruit in axillary solitary spikes. Calyx scaly, without prickles. Native of the mountains of Upper Nepaul, flowering in April. Buchanan. The Parbutties call it *Banza*, or *Banja*; the Nawars *Sofhi Shingali*. This is a tree of vast dimensions, with a scaly bark, and rigid, brown, warty branches, clothed, when young, with dense white down. Leaves alternate, somewhat two-ranked, stalked, elliptic-oblong, sometimes rather obovate, pointed, from

three to five inches in length, and two or more in breadth strongly and sharply serrated, except at the very base, which is more or less rounded, and occasionally unequal; the upper surface green, shining, and naked, (except when young), but not quite smooth to the touch; the under clothed with fine, dense, uniform, white, woolly pubescence, and marked with prominent, parallel, but not very crowded, obliquely-transverse veins. Footstalks stout, downy, scarcely an inch long. Stipulas ovate, membranous, deciduous. Male flowers in short, dense, hairy spikes, at the base of the young shoots, as they protrude from the bud. Calyx with five or six teeth. Anthers about six, sessile. Female flowers, as far as Dr. Buchanan could observe, on a separate tree, in very short, solitary, axillary spikes. Acorns either solitary, or several crowded together, small, ovate, hairy, half covered by their scaly unarmed cups.

28. *Q. diversifolia*. Various-leaved Mexican Oak. Willd. n. 21. Née in Annal. Scient. Nat. v. 3. 270. Fisch. Misc. Hist. v. 1. 107. Willd.—Leaves ovate, undivided or deeply toothed; yellow and downy beneath. Fruit spiked, globose.—Found by Louis Née, between the villages of Chalma and Santa Rosa in New Spain. A shrub, from ten to fourteen feet high; its trunk seldom straight; the bark cracked, dark-coloured; the branches alternate. Leaves either an inch and half long, and undivided, or two inches and a half, and deeply toothed; smooth and shining above; downy, and dull yellow, beneath. Footstalks hardly a line in length. Stipulas oblong, reddish, membranous, contracted at the base, deciduous. Acorns four or five, sessile, on a thread-shaped axillary stalk, two inches long. Cup the size and shape of a pea, covered with scales. Nuts scarcely projecting above a line beyond the cup. Née. The fruit, being sessile, is evidently spiked, not, as the authors quoted term it, racemose.

29. *Q. agrifolia*. Holly-leaved American Oak. Willd. n. 22. Née in Annal. Scient. Nat. v. 3. 271. Fisch. Misc. Hist. v. 1. 108. Willd. Pursh n. 9.—Leaves roundish-ovate, somewhat heart-shaped, smooth on both sides, with spinous teeth. Fruit axillary, sessile. Scales of the calyx lax. Nut ovate.—Native of the west (not east) coast of North America, near Monterey, and Nootka found. Née. Branches smooth, ash-coloured. Leaves about two inches long, and almost as wide, smooth, veiny, nearly heart-shaped, bordered with distant spinous teeth. Spikes of male flowers an inch long. Calyx shorter than the stamens. Anthers five, two-celled. Female flowers axillary, sessile, mostly two together. Calyx hemispherical, beset with lax yellow scales. Nut thrice as long as the calyx, measuring eight lines, ovate, acute. Née.

Plukenet's t. 196. f. 3, cited with doubt by Willdenow and Pursh, appears to belong, as Linnæus thought, to his own *Hippomane spinosa*. The shape of the leaves certainly does not agree with the above description, though perfectly answerable to Plumier's figure of this *Hippomane*, which is *Sapium ilicifolium* of Willdenow, Sp. Pl. v. 4. 573, who there copies the same synonym from Linnæus, without any mark of uncertainty.

30. *Q. gramuntia*. Holly-leaved Montpellier Oak. Linn. Sp. Pl. 1413. Willd. n. 23. Ait. n. 6. (Ilex foliis rotundioribus et spinosis, e luco gramuntio; Magn. Monsp. 140.)—Leaves roundish-elliptical, nearly sessile, undulated, with deep spinous divaricated teeth; densely downy beneath; somewhat heart-shaped at the base.—Native of the wood of Gramont, near Montpellier, and of Spain. Cultivated in England in 1730. It blossoms in June. This is rather a small straggling tree, with numerous round grey branches, downy when young. Leaves evergreen, scarcely an inch

long, rigid, broadly elliptical, often nearly orbicular, very much undulated at the margin, their deep broad spinous teeth pointing every way; the upper surface dark green, rather glaucous, besprinkled with minute starry hairs; the under densely clothed with white entangled down. We have seen neither *flowers* nor *fruit*. Willdenow appears mistaken in discarding the synonym of Magnol, which answers extremely well to the Linnæan specimens, though indeed the author speaks of his plant as a variety of *Q. Ilex*. It is, nevertheless, true that Linnæus confounded herewith a plant from Magnol's herbarium, which is not distinct from *Q. Ilex*.

31. *Q. Ballota*. Sweet-acorn Oak. Desfont. Atlant. v. 2. 350. Willd. n. 24. (*Ilex major*; Clus. Hist. v. 1. 23?)—Leaves elliptical, coriaceous; entire or ferrated; very downy beneath. Bark even. Nut cylindrical, elongated.—Native of several places in the neighbourhood of mount Athos, according to professor Desfontaines, from whom we have a wild specimen. It flowers in May. This is a large and handsome evergreen tree, whose trunk is from twenty to thirty feet high; the wood hard, compact, and very useful; the bark even, not corky, though full of fissures; branches downy. Footstalks a quarter of an inch long, downy. Leaves various in shape, but more or less elliptical, an inch or inch and half long; either quite entire, or ferrated with small spinous teeth; their upper surface, at least when young, besprinkled with minute starry hairs; the under always very white and densely downy. Male flowers in copious, long, lax, pendulous spikes, with usually seven stamens; female on the same tree, axillary, solitary or aggregate. Acorns cylindrical, an inch and half or two inches long, half an inch in diameter, eatable and very palatable, either raw or roasted. Cup hemispherical, covered with numerous, obtuse, downy, closely imbricated scales.

32. *Q. Ilex*. Common Evergreen Oak, or Holm Oak. Linn. Sp. Pl. 1412. Willd. n. 25. Ait. n. 7.—Leaves ovate-oblong, acute, coriaceous; entire or ferrated; hoary beneath. Bark even. Nut ovate. The varieties are; α , with lanceolate entire leaves; Smilax Dalech; Bauh. Hist. v. 1. part 2. 101. Suber secundus; Matth. Valgr. v. 1. 188, as to the figure: β , with lanceolate ferrated leaves; Ilex; Matth. Valgr. v. 1. 186. Duham. Arb. v. 1. t. 123: γ , with rounder, less rigid, and more or less ferrated leaves; Phellodrys; Matth. Valgr. v. 1. 189, as to the figure. Ilex n. 3; Duham. Arb. v. 1. t. 124. This species occurs in various parts of the south of Europe, and north of Africa, and is hardy, as well as evergreen, with us, thriving particularly near the sea, though of slow growth, flowering in May and June. It usually forms a large bushy tree, but occasionally rises with a straight naked trunk, and round head, to a great height. The wood is hard and heavy, valuable for many purposes. The French use it for pullies in the navy. The bark is hard and even, not corky. Leaves various in shape and size; dark green, convex, and quite smooth, above; hoary or downy beneath; their edges either revolute and entire, or irregularly notched and ferrated. Footstalks half an inch long, downy. Acorns usually two, on an axillary downy stalk which is longer than the footstalk, ovate, hardly an inch long, with a scaly downy cup. They are eaten by hogs, but are very different in shape and quality from those of the last-described species. So many varieties, or species, nearly corresponding with these two, are mentioned by authors, that it is difficult to understand them. The subject requires, and well deserves, a practical investigation. Lamarck, under the article Chêne, in his dictionary, mentions several kinds, which he knew but imperfectly, and which we have no means of elucidating further,

so that we dare not adopt, or attempt to reduce them to order.

33. *Q. Suber*. Cork Tree. Linn. Sp. Pl. 1413. Willd. n. 26. Ait. n. 8. Hunter's Evel. Sylv. 362, with a plate. (Suber; Camer. Epit. 115. S. primus; Matth. Valgr. v. 1. 187. S. latifolium, perpetuo virens; Duham. Arb. v. 2. 291. t. 80. S. latifolium; Ger. Em. 1347, the middle figure only.)—Leaves ovate-oblong, bluntish, coriaceous; entire or sharply ferrated; downy beneath. Bark cracked, fungous.—Native of the south of Europe, and north of Africa. Duhamel says it can hardly bear the climate of the north of France. It lives however in our English gardens, where it has been kept more than a century. The bark is remarkable for a thick spongy coat, yielding the well-known substance called cork. The leaves much resemble the broad variety of *Q. Ilex*, nor do the acorns greatly differ from those of that tree. We have not been able to ascertain what authors mean by their *Suber angustifolium non ferratum*, the figure of which, Matth. Valgr. v. 1. 188. Duham. Arb. v. 2. t. 81, we have cited as our first variety of *Ilex*. We should suspect the *Suber* itself to be altogether a variety of *Ilex*, differing only in the bark; and that there might be a broad and a narrow-leaved variety of each; were not the dwarf tufted stumpy habit of the Cork Tree, on the sandy plains of Italy, Spain, &c. so peculiar. Yet this possibly may, as well as the nature of the bark, be owing to the soil, for in strong ground the cork, according to Duhamel, degenerates. Willdenow says "the leaves of *Q. Suber* are a little elongated at the base, running down into the footstalk, which is not the case with *Ilex*;" but this character seems scarcely permanent.

34. *Q. coccifera*. Kermes Oak. Linn. Sp. Pl. 1413. Willd. n. 27. Ait. n. 9. (*Ilex coccifera*; Camer. Epit. 774. I. aculeata cocciglandifera; Garid. Aix. 245. t. 53. Nilole in Mem. de l'Acad. des Sciences for 1714. 435. t. 17, 18. I. coccigera; Ger. Em. 1342.)—Leaves elliptic-oblong, rigid, smooth on both sides, with spreading, bristly, spinous teeth. Nut ovate. Calyx with spreading pointed scales.—Native of the south of Europe, and the Levant, flowering in the spring. This is a bushy evergreen shrub, celebrated for producing the kermes, a valuable article of dyeing, before the introduction of cochineal, and which afforded the color kermesinus, or crimson. The kermes is an insect, of the genus *Coccus*, which sticks to the branches, in the form of a red ball, the size of a pea. It is now out of use among dyers, and is only used by French apothecaries. The leaves of this shrub are, at most, but half the size of the last, though they vary much in magnitude as well as figure. They are distinguished by their rigidity, smoothness on both sides, and their prominent needle-like marginal prickles. The scales of the mature calyx are also much more elongated and prominent than in *Ilex* or *Suber*, and of an angular awl-shaped figure.

35. *Q. Pseudo-coccifera*. Baitard Kermes Oak. Desfont. Atlant. v. 2. 349. Willd. n. 28.—Leaves elliptic-oblong, rigid, smooth on both sides, with spinous serratures. Nut ovate. Calyx with flat, slightly spreading, scales.—Observed by Desfontaines at Algiers and about mount Athos. At Tunis it is called the "meal-bearing oak," probably from the use of the acorns as food. This is a tree, from fifteen to twenty feet high, with round branches, clothed with rusty down when young. The leaves are twice or thrice as large as those of *Q. coccifera*, thicker and less wavy, with much smaller and shorter spinous serratures, rather than teeth. Calyx clothed with numerous, flat, short, slightly spreading scales. Nut ovate, pointed. Willdenow, not having seen a specimen, has misunderstood the

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the nature of the *calyx*, and has in other respects altered Desfontaines' specific character for the worse.

36. *Q. rigida*. Rigid-leaved Oak. Willd. n. 29.—(*Ilex aculeata cocciglandifera*, glande maximâ, nunc cylindraceâ, nunc subrotundâ, cupulâ echinatâ; Tourn. Cor. 40?—"Leaves oblong, undivided, with spinous serratures, smooth; glaucous beneath; heart-shaped at the base. Footstalks bearded at the summit. Scales of the calyx of the fruit rigid, spreading."—Native of the coast of Caramania. Willdenow. A pretty species, sufficiently distinct from its allies. Branches pale brown, dotted. Leaves oblong, an inch or rather more in length, rigid, with spinous serratures; deep green and shining above; glaucous beneath; cordate at the base. Footstalks very short, smooth, except at the top, where a line of brownish hairs, on each side, runs up the midrib. Calyx of the fruit sessile, beset with rigid, woody, lanceolate, spreading scales. Willd.

A specimen before us, gathered by the late Dr. Broussonet at Algiers, answers precisely to this description, especially in the curious character of the hairy lines, running a little way up the midrib of the leaf; but the foliage is equally green and shining on both sides. The *calyx* resembles that of *coccifera*, but its inner scales are longer, and more spreading.

37. *Q. rotundifolia*. Round-leaved Spanish Oak. Lamarck Dict. v. 1. 723. Willd. n. 30.—"Leaves obovate-oblong, abrupt, with spinous teeth; heart-shaped at the base; smoothish above; downy beneath."—Native of Spain. Seen by Lamarck, in a young state, in the garden of Monf. Cels, and by Willdenow dry without fructification. The branches are round and downy. Leaves stalked, an inch or more in length; glaucous-grey, and not quite smooth, above; white and cottony beneath. The acorns are said to be large and long, eatable like chestnuts. This description is not inapplicable, on the whole, to our n. 31, *Q. Ballota*.

38. *Q. humilis*. Dwarf Portuguese Oak. Lamarck Dict. v. 1. 719. Willd. n. 31. Ger. Em. 1340. (*Q. pedem vix superans*; Bauh. Pin. 420. Robur 7; Clus. Hist. v. 1. 19.)—Leaves obovate, with spinous serratures; heart-shaped at the base; downy beneath. Calyx of the fruit flattened. Nut oblong.—Found by Clusius in barren sandy ground near Lisbon, very abundantly. The whole plant is rarely more than a foot high when wild; though Lamarck says it becomes twice or thrice as tall by culture. The young branches are downy. Leaves an inch, or inch and half long, on short footstalks; smooth and shining above; downy and hoary beneath; their larger veins straight and parallel. The acorns are described as more bitter than our common oak, their form oblong, their cups remarkably short and flattened.

39. *Q. lusitanica*. Portuguese Gall Oak. Lamarck Dict. v. 1. 719. Willd. n. 32. (*Q. valentina*; Cavan. Ic. v. 2. 25. t. 129? Robur 4; Clus. Hist. v. 1. 18, and R. 5; ibid. 19. Galla five Robur majus; Ger. Em. 1348, and G. minor; ibid. 1349.)—"Leaves elliptical, with deep pointed serratures; downy beneath. Fruit racemose. Calyx hemispherical. Nut oblong."—Native of Portugal, and perhaps Spain. Lamarck says this species consists of several varieties, all very low shrubs, subject to bear galls; their branches copious and slender; their leaves small, intermediate in form between the evergreen and the ordinary oaks of Europe. Willdenow describes the leaves an inch in length, oblong, obtuse, rigid; their serratures somewhat pointed; the upper surface polished and smooth; the under hoary with slender, lanky, crowded hairs. Footstalks short. Fruit racemose, or rather, as we should imagine, spiked. He adds that the figure of Cavanilles scarcely answers to the

plant in question; and indeed that author describes his as a lofty tree, taller than *Q. Ilex*, with deciduous leaves, and large, solitary acorns. We have seen no specimen.

40. *Q. infectoria*. Oriental Gall Oak. Olivier's Travels, English edition, v. 2. 42. t. 14, 15. Willd. n. 33.—Leaves ovate-oblong, very smooth on both sides, deeply toothed, somewhat sinuated, deciduous. Fruit sessile. Calyx tessellated. Nut elongated, nearly cylindrical.—This oak, according to Olivier, is scattered throughout all Asia minor, from the Bosphorus as far as Syria, and from the coasts of the Archipelago, as far as the frontiers of Persia. It seldom attains the height of six feet, and the stem is crooked, with the habit of a shrub rather than a tree. The leaves are an inch or inch and half long, deciduous, bright green, smooth on both sides, but paler beneath; their serratures deep and broad, not acutely pointed. Fruit solitary, nearly sessile. Cup slightly downy, its scales not very distinct. Acorn two or three times longer than the cup, smooth, nearly cylindrical. The galls produced on the young branches of this oak, from the puncture of a species of *Diplolepis*, are preferred to all others for dyeing, and are a great article of the Levant trade. (See GALLS.) Olivier observes that the plant bears a number of different galls, besides the above, which are neglected, as useless.

41. *Q. mucronata*. Pointed-toothed Mexican Oak. Willd. n. 34. (*Q. castanea*; Nee in Annal. Scient. Nat. v. 3. 276. Fisch. Misc. Hist. v. 1. 114. Willd.)—"Leaves oblong-lanceolate, with pointed awned serratures; polished above; downy beneath; heart-shaped at the base."—Found by Louis Nee, without flowers or fruit, in New Spain, between Ixmiquilpan and Cimapan. The tree is twelve feet high, with a straight trunk, covered with a brittle dark-coloured bark. Branches erect, alternate, smooth, much sub-divided. Leaves three inches long, and one broad, acute; abrupt and heart-shaped at the base, their serratures awned; the upper surface green and smooth; the under clothed with fine yellow down. Footstalks two lines long. Stipulas none. Nee.

42. *Q. tomentosa*. Downy Mexican Oak. Willd. n. 35. (*Q. peduncularis*; Nee in Annal. Scient. Nat. v. 3. 270. Fisch. Misc. Hist. v. 1. 106. Willd.)—"Leaves oblong-ovate, with tooth-like notches; densely downy beneath. Fruit racemose. Nut globose, nearly covered by the calyx."—Native of New Spain, in the road from Mexico to Acapulco, beyond the river Mescala. A tree, twenty feet high, with an upright trunk, and grey brittle bark. Branches numerous, alternate, clothed with dense reddish wool. Leaves five inches long, hardly two wide, crowded; obtuse at the base; pointed at the end; bordered with tooth-like notches; green and smoothish above; downy, with prominent veins, beneath. Footstalks downy, very short. Female flowers on an axillary solitary stalk, three or four inches long. Acorns but little bigger than pepper-corns, each almost entirely concealed in its scaly, downy, reddish cup. Nee. This species agrees with our thirteenth, *tribuloides*, in having its acorn concealed by the cup. The fruit is described, by the authors we are obliged to copy, as racemose. We have seen no specimens, but analogy would induce us to suppose it rather spiked.

43. *Q. circinata*. Round-toothed Mexican Oak. Willd. n. 36. Nee in Annal. Scient. Nat. v. 3. 272. Fisch. Misc. Hist. v. 1. 109. Willd.—"Leaves ovate, crenate, undulated; acute at each end; downy beneath. Nut scarcely longer than the calyx."—Native of New Spain, between Tixtala and Chilpancingo. A tree twenty or twenty-five feet high. Trunk erect. Bark brittle, ash-coloured. Branches horizontal; the young ones erect, furrowed,

rowed, villous. *Leaves* alternate, from five to seven inches long, and three broad; green and shining above; more or less downy, and flesh-coloured, or reddish-brown, beneath; the margin undulate and crenate, the notches rounded, their edges turned towards the point of the leaf. *Fruit* supported by a very short common stalk. *Calyx* hemispherical, the size of Chick peas, *Cicer arietinum*; its scales acute at the point. *Nut* but little larger than the calyx. Plukenet's t. 54. f. 3, in some measure resembles the species before us, but is said to have a large fruit, and is cited by authors as *Q. Prinus*. Nee.

44. *Q. splendens*. Silky-leaved Mexican Oak. Willd. n. 37. Nee in Annal. Scient. Nat. v. 3. 275. Fisch. Misc. Hist. v. 1. 113. Willd.)—"Leaves oblong-ovate, bluntly toothed; slightly downy above; densely silky beneath."—Native of New Spain, near Taxala. *Trunk* erect, much branched, fifteen feet high. *Branches* partly horizontal, partly erect, clothed with red shining down. *Leaves* scattered, crowded, three inches long, and an inch and half broad; green, with a thin downy coat, above; thickly clothed beneath with shining pubescence, the midrib only being prominent; their edges bluntly and unequally toothed. *Footstalks* very short, with an awl-shaped villous *stipula* at each side. *Flowers* and *fruit* not observed. Nee.

45. *Q. rugosa*. Rugged Mexican Oak. Willd. n. 38. Nee in Annal. Scient. Nat. v. 3. 275. Fisch. Misc. Hist. v. 1. 112. Willd.)—"Leaves ovate-oblong, coriaceous, rugose; toothed towards the end; heart-shaped at the base; downy and rusty beneath."—Native of the woods of Huicquiluca and Ocuila, in the way from Mexico to Santo Christo de Chalma. A middle-sized tree, having numerous, alternate, round, grey branches, rough with minute prominent points. *Leaves* three inches in length, hardly two in breadth, thick and coriaceous; rugged, green and shining on the upper side; brown and downy at the back; heart-shaped at the base; the margin toothed from the middle to the extremity. *Footstalks* two lines long, thickened at their base. *Female flowers* in fealy axillary clusters. Nee.

46. *Q. macrophylla*. Large-leaved Mexican Oak. Willd. n. 39. Nee in Annal. Scient. Nat. v. 3. 274. Fisch. Misc. Hist. v. 1. 111. Willd.)—"Leaves obovate, crenate; tapering and heart-shaped at the base; downy beneath. *Fruit* spiked."—Found by Louis Nee, the discoverer like-wise of the five preceding species, in the districts of Chilpancingo and La Curva, and on the mountains of Quirapu, in New Spain. This is a tree, thirty feet high, with a stout upright *trunk*, and dense *head*. The principal *branches* are horizontal; the rest upright, furrowed when young. *Leaves* a foot long, and seven or eight inches broad; rounded at the end; gradually tapering down to the emarginate, or heart-shaped, base, where they measure only four lines across; their upper surface green and shining; the under yellowish, clothed with very minute down; the margin crenate and wavy. *Footstalks* very short and thick. *Female flowers* sessile on a common stalk, and encompassed with downy bractæas. Nee.

47. *Q. Prinus*. Chesnut-leaved White Oak. Linn. Sp. Pl. 1413. Willd. n. 40. Ait. n. 10. Pursh n. 30. (*Q. Prinus*, var. 1, *palustris*; Michaux Querc. n. 5. t. 6. *Q. castanæ foliis*, *procera arbor virginiana*; Pluk. Almag. 309. Phyt. t. 54. f. 3. Cateb. Carol. v. 1. t. 18.)—"Leaves on longish stalks, obovate, acute; somewhat downy beneath; with nearly equal, dilated, callous-tipped, tooth-like serratures. *Calyx* of the fruit contracted at the base. *Nut* ovate.—Found in low shady moist woods, and on the banks of rivers, from Pennsylvania to Florida, flowering in May. It appears to have been known in England in 1730.

This is one of the tallest trees produced in the southern parts of the United States, and remarkable for the beauty of its form, as well as the large size of its *acorns*, which are plentiful and sweet, a delicious and beneficial food for hogs and other wild animals. The *wood* is excellent, much used for making wheel-carriages, and yet so readily split as to serve for basket-work and brooms. The *leaves* are six inches, or more, in length, and three broad; silky in the spring; smooth and glaucous in summer; sometimes very downy on old trees. *Footstalks* an inch long. *Stamens* five to ten. *Acorns* an inch and half long, ovate; their cups shallow, covered with numerous closely-imbricated scales. Michaux says the *bark* is whitish, peeling off in long strips.

48. *Q. Chinquapin*. Chinquapin, or Dwarf Chesnut Oak. Pursh n. 34. (*Q. prinoides*; Willd. n. 41. *Q. Prinus*, var. 4, *pumila*; Michaux Querc. n. 5. t. 9. f. 1. *Q. Prinus* Chinquapin; Michaux Arb. v. 2. 65. t. 10, good. Pursh.)—"Leaves on short stalks, obovate, smooth; glaucous beneath; tapering at the base; with nearly equal, dilated, acute, callous-tipped, tooth-like serratures. *Calyx* of the fruit hemispherical. *Nut* ovate.—Found on dry mountainous lands, from Pennsylvania to Carolina, flowering in May, when, according to Mr. Pursh, it is highly ornamental. This is a humble *shrub*, not above three or four feet high. The young *leaves* are whitish and downy beneath; the adult ones smooth and glaucous, scarcely above one-third the size of the preceding. *Female flowers*, according to Michaux, small, two or three together, on a short, solitary, axillary *stalk*. *Acorns* of a middling size, with a thin, nearly hemispherical, cup.

49. *Q. montana*. Rock Chesnut Oak. Willd. n. 42. Pursh n. 32. (*Q. Prinus*; Sm. in Abbot's Inf. v. 2. 163. t. 82. *Q. Prinus*, var. 2, *monticola*; Michaux Querc. n. 5. t. 7.)—"Leaves on shortish stalks, obovate, acute; downy and white beneath: with nearly equal, dilated, short, blunt, callous-tipped tooth-like serratures. *Fruit* in pairs, on short stalks. *Calyx* hemispherical, with rugged scales. *Nut* oblong-ovate.—Found abundantly, in rocky situations, on the mountains of North America, from New England to Carolina, flowering in May. Michaux suggests that this species would be well worth cultivating in Europe. The *tree* rises to the height of sixty feet; the *wood* is tough and very useful, the *bark* excellent for tanning. It differs from *Q. Prinus*, n. 47, with which it has been confounded, in the constant white downiness of the under side of the *leaves*, which are much smaller and less dilated upward. The *acorns* moreover are but half the size of that species, and more oblong, two together on a very short stalk.

50. *Q. bicolor*. Swamp White Oak. Willd. n. 43. Pursh n. 31. (*Q. Prinus*, var. 5, *tomentosa*; Michaux Querc. n. 5. t. 9. f. 2. *Q. Prinus* discolor; Michaux Arb. v. 2. 46. t. 6. Pursh.)—"Leaves nearly sessile, obovate; downy and white beneath; with very broad, unequal, obtuse, callous-tipped, lobe-like teeth. *Fruit* in pairs, on long bristle-pointed stalks. *Calyx* hemispherical. *Nut* oblong-ovate.—Native of low wet woods, from Pennsylvania to Carolina, flowering in May. Pursh. It grows to a very large tree. The *leaves* have extremely broad shallow teeth, or, as they might be called, lobes, approaching to the figure of our common English Oak leaves; their under side white and very downy. The *acorns* are sweet and eatable, like most of the *Prinus* tribe. Willdenow says the teeth are occasionally variable in size, one or two of them being sometimes remarkably elongated; and that the base of the *leaf* is more entire than in the foregoing.

51. *Q. Castanea*. Yellow Oak. Willd. n. 44. Pursh n. 33. (*Q. Prinus*, v. 3, *acuminata*; Michaux Querc. n. 5. t. 8.)

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t. 8.)—Leaves on long footstalks, oblong-lanceolate, pointed; somewhat downy beneath; with numerous, nearly equal, dilated, acute, callous-tipped, tooth-like serratures. Calyx hemispherical. Nut roundish-ovate.—Found in the Allegany mountains, and on the banks of the Delaware, flowering in May. *Pursh*. Michaux says it occurs in all the fertile countries to the west of those mountains; and as the temperature of that climate agrees with the north of Europe, the tree in question would be well worth trying here. The wood is excellent; bark very serviceable in tanning; and the acorns sweet. The tree is large and handsome, seventy or eighty feet high. Leaves much like those of our Sweet Chestnut in form, but glaucous and often downy beneath. Acorns much rounder than in any of the four preceding, and shorter in proportion to the cup. These Chestnut Oaks, *Prinus* and its allies, seem not to have as yet attracted the notice of European cultivators, perhaps from their having been improperly confounded by botanists. The above accounts of their distinctions, and their valuable qualities, it is hoped, may cause them to be fought out, and introduced into this country. Their different acorns might surely be easily imported.

Section 3.—*Leaves lobed at the extremity.*

52. *Q. aquatica*. Water Oak. Soland. in Ait. Hort. Kew. ed. 1. v. 3. 357. ed. 2. n. 11. Willd. n. 45. *Pursh* n. 11. Michaux Querc. n. 11. t. 19. t. 20. f. 1, 3, 4, 5, and t. 21. (*Q. foliis cuneiformibus, obsolete trilobis, intermedio productiore*; Gron. Virg. 149. *Q. folio non ferrato, in summitate quasi triangulato*; Catesb. Carol. v. 1. t. 20. Herb. Linn.)—Leaves wedge-shaped, smooth; tapering at the base; dilated and obscurely three-lobed at the end, the middle lobe largest. Calyx nearly hemispherical. Nut roundish.—Native of swamps in North America, from Maryland to Florida, blossoming in May. Miller is said to have cultivated this species in 1748, but it is little known in England. The tree is forty feet high; its wood, according to *Pursh* and Michaux, is little esteemed; but the latter is of opinion that it might prove more valuable if felled in winter; he mentions also that the tree is not peculiar to swamps, or inundated meadows, but occurs sometimes in dry sandy ground, as on plains near the sea-coast of Florida. Few trees vary so much in the shape of their leaves, according to age or situation, as this. The proper form of its foliage is wedge-shaped, much elongated and tapering at the base; dilated, rhomboid, or very slightly and bluntly three-lobed at the extremity; the edges entire; both sides usually smooth. Footstalks variable in length, but rather short; clothed, when young, with starry hairs, which are sometimes scattered over the back of the young leaf. Some of its leaves however, even on the same tree, are deeply three-lobed; and those of young plants are, the first year, oblong and quite entire; the next two or three seasons, variously toothed and sinuated; inasmuch that botanists know not well how to distinguish its varieties from some of the following species. The acorns are short and roundish, with a shallow cup, and stand generally in pairs, on short stalks.

53. *Q. nigra*. Barren Oak, or Black Jack. Linn. Sp. Pl. 1413. Willd. n. 46. Ait. n. 12. *Pursh* n. 15. Sm. in Abbot's Inf. v. 2. 115. t. 58. Michaux Querc. n. 12. t. 22, 23. (*Q. marylandica, folio trifido, ad fassafra accedente*; Catesb. Carol. v. 1. t. 19.)—Leaves wedge-shaped; somewhat heart-shaped at the base; dilated, abrupt, and very slightly three-lobed at the end; the middle lobe shortest; smooth above; rusty beneath. Calyx hemispherical, with membranous scales. Nut roundish-ovate.—In barren sandy or gravelly woods, from New Jersey to Florida, flowering in May. This tree is of low growth, especially in the more

northern states. It bears abundance of acorns, very good food for hogs. The wood is small, but excellent for fuel. *Pursh*. The leaves are twice or thrice the size of the last, singularly dilated, and abrupt, at the end; their lobes, when young, more evident, and each tipped with a bristle, which soon falls off. Acorns mostly in pairs, nearly sessile, with very fealy cups.

54. *Q. triloba*. Downy Black Oak. Willd. n. 47. Ait. n. 13. *Pursh* n. 14. Michaux Querc. n. 14. t. 26. (*Q. rubra*; Abbot's Inf. v. 1. 99. t. 50.)—Leaves wedge-shaped, with three terminal, bristly-pointed lobes, the middle one longest; downy beneath. Calyx of the fruit flattish. Nut nearly round.—Native of barren tracts, near the sea-coast, from New Jersey to Georgia, flowering in May. It was brought to England in 1800, by Messrs. Frazer. The tree is fifty or sixty feet high, of rapid growth, even in a poor soil. Michaux describes it as very fit for making live fences; though the wood is most generally used in America for paling. The leaves are much smaller than those of *Q. nigra*, rounded, not heart-shaped, at the base, and with longer footstalks. Their lobes are direct, not laterally dilated, each tipped with one or more small bristles, and the under side is covered with dense white down. The foliage of young shoots, that spring up where forests of this tree have been burnt, are often near a foot long, deeply pinnatifid, and sharply lobed; as represented in Michaux, t. 26. f. 2.

55. *Q. nana*. Dwarf Jagged Oak. Willd. n. 48. *Pursh* n. 13. (*Q. aquatica*; Sm. in Abbot's Inf. v. 2. 117. t. 59. *Q. aquatica elongata*; Ait. n. 11, 7.)—Leaves oblong-wedge-shaped, smooth, somewhat sinuated; three-lobed at the extremity: lobes divaricated, pointed, the middle one largest; forks of the vein downy beneath.—In barren lands, called pine-barrens, of South Carolina, flowering in May. *Pursh* describes it as “a low-growing species, always keeping distinct from *Q. aquatica*.” The leaves are almost sessile, two or three inches long, much more distinctly lobed than in *aquatica* or *nigra*, and more sinuated or angular besides, than in any of the three last described. The acorns are almost globular, with a very shallow cup.

Section 4.—*Leaves sinuated, with pointed lobes.*

56. *Q. hemisphaerica*. Hemispherical Oak. “Bartram's Travels 320.” Willd. n. 49. *Pursh* n. 12. (*Q. aquatica maritima*; Michaux Querc. n. 11. t. 20. f. 2.)—“Leaves evergreen, oblong-lanceolate; undivided, three-lobed, or sinuated; smooth on both sides; lobes pointed.” Willd.—Native of Georgia and Florida. Some of the leaves are very deeply three-lobed, or pinnatifid; others linear-oblong and undivided. Willdenow says they are evergreen, and that the foliage of the young plant is so like *Q. phellos*, our first species, as to be hardly distinguishable. Michaux, however, asserts this supposed species to be but a maritime variety of *aquatica*, and *Pursh* thinks it a young plant of that kind.

57. *Q. elongata*. Downy-leaved Oak. Willd. n. 50. Ait. n. 14. (*Q. falcata*; Michaux Querc. n. 16. t. 28. *Pursh* n. 22. *Q. discolor*; Ait. ed. 1. v. 3. 358.)—Leaves downy beneath, sinuated, with three or more somewhat falcate, bristle-pointed lobes; the terminal one elongated, jagged. Calyx hemispherical.—In sandy soil, near the sea-coast; from New Jersey to Georgia, flowering in May. A very large tree, commonly called Spanish Oak; in the southern states, Red Oak. *Pursh*. The height of the tree is fifty or sixty feet. Leaves on long stalks; obtuse or rounded at the base; deeply lobed, or in some measure palmate; the lobes often recurved, or sickle-shaped; taper-pointed, and more or less notched at the end, each segment tipped with a long bristle. Acorns small, roundish; its cup hemispherical, with

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lax scales. The *leaves* of young trees are said to be very like those of *triloba*, n. 54.

58. *Q. tinctoria*. Dyers' Oak, Black Oak, or Quercitron. Willd. n. 51. Ait. n. 15. Pursh n. 16. (*Q. tinctoria angulosa*; Michaux Querc. n. 13. t. 24. *Q. discolor*; Willd. Arb. 274.)—Leaves downy beneath, obovate-oblong, dilated, widely sinuated; lobes short, obtuse, slightly toothed, bristle-pointed. Calyx of the fruit flat underneath. Nut globose.—In all large woods, particularly in the mountainous parts, from New England to Georgia, flowering in May. It is one of the largest trees of the American forest, highly valuable for its timber, as well as bark, which last is so very superior in tanning to any other species of Oak. Pursh. Michaux says, this Oak is found only in a good soil, always at a distance from the sea; attaining its greatest size, which is eighty feet in height, and eight in diameter, in the vallies between the high mountains of North Carolina. The bark is used by tanners, throughout the north and west parts of the United States. It gives a yellowish colour, whence the name of Quercitron, and which enhances the value of the leather. The bark, bruised and powdered, was in great request among dyers in France, before the war interrupted this branch of commerce. The *leaves* are conspicuous for their broad, angular, abrupt figure, a span long, and nearly as wide, with shallow sinuses, and bristle-tipped angles. *Acorns* almost sessile, globular, with a scaly, shallow, flat-tish cup.

59. *Q. discolor*. Sinuous Dyers' Oak. Willd. n. 52. Pursh n. 17. Sm. in Abbot's Inf. v. 2. 111. t. 56. (*Q. tinctoria sinuosa*; Michaux Querc. n. 13. t. 25. *Q. virginiana*, venis rubris muricata; Pluk. Phyt. t. 54. f. 5.)—Leaves downy beneath, oblong, pinnatifid; leaves oblong, toothed, bristle-pointed. Calyx turbinate. Nut ovate.—In large forests, from Pennsylvania to Carolina, flowering in May. This resembles the preceding and *Q. coccinea*, n. 61. The young expanding *leaves* are covered with white down on both sides, which is not the case with either *rubra* or *coccinea*. Pursh. This differs from the last in having much more sinuated, or pinnatifid *leaves*, and larger, more ovate, *acorns*, whose cups are turbinate, or tapering at the base. The qualities of the wood and bark probably agree with the *tinctoria*, or Michaux, who considers the present plant as but a variety, would have mentioned the contrary.

60. *Q. rubra*. Mountain Red Oak. Linn. Sp. Pl. 1413. Willd. n. 53. Ait. n. 16. Pursh n. 20. Michaux Querc. n. 20. t. 35, 36. Abbot's Inf. v. 2. 205. t. 103. (*Q. esculi divifura*, foliis amplioribus aculeatis; Pluk. Phyt. t. 54. f. 4.)—Leaves smooth, oblong, sinuated, on long stalks; lobes acute, sharply toothed, bristle-pointed. Calyx of the fruit flat underneath. Nut ovate.—Native of forests on a fertile soil, from Canada to Pennsylvania, and in all the country west of the Allegany mountains, blossoming in May. It was cultivated by Miller before 1739, and is to be found in several plantations. A large and handsome timber tree, of rapid growth; its *wood* highly useful for building and for carriages; and the *bark* is said by Michaux to be the very best known for tanning, the European tanners, settled in America, having found it, by experiment, more efficacious than any of the oak barks of Europe. The *tree* is ninety or one hundred feet high. *Leaves* four or five inches long, on *foot-stalks* about half that length; unequally sinuated or pinnatifid, with rather spreading, but not remote, lobes, whose ends are very acute, as well as, here and there, sharply toothed, each tooth and point tipped with a long bristle. *Acorns* rather large, ovate, with a shortish flat-bottomed cup. The *leaves* turn of a deep red in autumn, which hue is common to most American trees and shrubs, in a greater or less

degree. Pursh says, this is exclusively known by the name of Red Oak, though various others are so denominated in several parts of America.

61. *Q. ambigua*, Michaux Arb. v. 2. 120. t. 24. Pursh n. 19, is supposed by the latter to be a hybrid between this and the following.

61. *Q. coccinea*. Scarlet Oak. Willd. n. 54. Ait. n. 17. Pursh n. 18. Michaux Querc. n. 18. t. 31, 32. (*Q. rubra* β ; Ait. ed. 1. v. 3. 357.)—Leaves smooth, oblong, deeply and widely sinuated, on long stalks; lobes divaricated, acute, sharply toothed, bristle-pointed. Calyx of the fruit turbinate, half as long as the nut.—Native of woods, on a fertile soil, from New England to Georgia, blossoming in May. This was one of the first American trees brought to Europe, having been cultivated before the end of the 17th century, by bishop Compton, as well as by the first earl of Portland. The bright red of the foliage in autumn gives the tree a beautiful and striking appearance, both in its native forests and our European plantations. It nearly equals the preceding in size; the *wood*, according to Michaux, is better, but the *bark* less valuable. The *leaves* are larger, with deeper, more rounded, sinuses, and more distant lobes. *Acorns* half covered by the deeper, more turbinate, cup.

62. *Q. Catesbaei*. Barren Scrub Oak. Willd. n. 55. Pursh n. 21. Michaux Querc. n. 17. t. 29, 30. (*Q. rubra* β ; Sm. in Abbot's Inf. v. 1. 27. t. 14. *Q. esculi divifura*, foliis amplioribus aculeatis; Catesb. Carol. v. 1. t. 23.)—Leaves smooth, oblong; wedge-shaped at the base; deeply and widely sinuated, on short stalks; lobes three or five, divaricated, acute, two or three-cleft, bristle-pointed. Calyx of the fruit turbinate, half as long as the nut.—Native of dry barren ground in Maryland, Virginia, Carolina, and Georgia, abundantly, flowering in May. This species is shrubby, not above fifteen feet high; its *wood* of a bad quality, used only for firing. The shortness of the *foot-stalks*, and the fewness of the lobes of the *leaves*, added to their acute base, are sufficient botanical distinctions between the present and the two last, especially as the size and quality of the tree are so unlike those species.

63. *Q. palustris*. Marsh, or Pin, Oak. Willd. n. 56. Ait. n. 18. Pursh n. 23. Michaux Querc. n. 19. t. 33, 34.—Leaves smooth, oblong, deeply and widely sinuated, on long stalks; lobes distant, parallel, acute, sharply toothed, bristle-pointed; forks of the veins densely woolly beneath. Calyx of the fruit flattened. Nut nearly globose.—Native of low swampy woods, from New England to Pennsylvania, and in the Illinois country, flowering in May. Messrs. Frazer are recorded as having brought this species to England in 1800, but it was previously cultivated in Holland and France. This is a large tree, whose wood is tough, used for making spokes of wheels. The *leaves* are smaller than those of *rubra* or *coccinea*, and with more numerous lobes than *Catesbaei*; their sinuses rounded and very wide, and the forks at the origin of their veins marked by a tuft of glandular hairs. The *acorns* are small, globular, with shallow cups, and generally very abundant.

64. *Q. acutifolia*. Pointed-leaved Mexican Oak. Willd. n. 57. Née in Annal. Scient. Nat. v. 3. 267. Fisch. Misc. Hist. v. 1. 102. Willd.—“Leaves ovato-lanceolate, sinuated, taper-pointed; unequal at the base; lobes toothed, bristle-pointed; forks of the veins villous beneath. Fruit racemose.”—Native of New Spain, in the road from Acapulco to Mexico. This is the largest of all the Oaks in New Spain. *Trunk* thick, twenty-five feet high, ornamented with a dense head of innumerable branches. *Leaves* from five to seven inches long, an inch and a half or two

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inches broad, their *footstalks* an inch in length; ovate and unequal at the base, gradually contracting upwards to a sharp point, sinuated, beset with awl-shaped teeth; green and shining above; reddish and veiny beneath, the forks of the veins villous. *Female flowers* in axillary four-flowered clusters, (or rather, we presume, *spikes*.) *Germens* ovate. *Acorns* small, scarcely so big as a pea, nearly covered by the cup, which is clothed with blackish scales. *Nee*.

65. *Q. candicans*. Hoary Mexican Oak. Willd. n. 58. *Nee* in *Annal. Scient. Nat.* v. 3. 277. Fisch. *Misc. Hist.* v. 1. 115. Willd.—“Leaves ovate, sinuated; white and downy beneath; lobes toothed, bristle-pointed.”—Native of New Spain, in sandy ground near Tixtala. A tree of a middling size, with a dense head of upright branches. Leaves nine inches long, four wide, tapering at each end, sinuated, with bristle-pointed teeth; green and smooth above; white and downy underneath. *Footstalks* four lines in length. *Flowers* and *fruit* not observed. *Nee*.

66. *Q. ilicifolia*. Holly-leaved, or Bear Oak. “Wangenh. *Amer.* 79. t. 6. f. 17.” Willd. n. 59. Ait. n. 19. (Q. Banisteri; Michaux Querc. n. 15. t. 27. Pursh n. 24. Q. aquatica? Sm. in Abbot’s *Inf.* v. 2. 157. t. 79?)—Leaves obovate-wedge-shaped, with three or five deep bristle-pointed lobes, entire; downy beneath. Fruit stalked, in pairs.—Found in dry barren fields, and on mountains, from New Jersey to Virginia, flowering in May; covering, wherever it occurs, large tracts of ground, thence termed Oak-barrens. It is known by the name of Bear Oak, Black Scrub Oak, and Dwarf Red Oak. Pursh. A shrub four to six feet, occasionally more, in height, with downy branches. *Footstalks* downy, near an inch long. Leaves two inches, or two inches and a half long, and near two wide, tolerably uniform, acute at the base, cut into five, rarely but three, deep divaricated, broad, acute lobes, entire at the margin, and scarcely toothed at the summit, though tipped with one or two bristles; the upper side green, veiny, and smooth; the under pale, and finely downy. *Female flowers* in pairs, on thick, solitary, axillary, downy stalks, much shorter than the *footstalks*. *Acorns* about half an inch long, nearly globular, half covered by their scaly hemispherical cups. Michaux thinks this species would serve well for making quick hedges. A specimen from Kalm, unnamed, is in the Linnæan herbarium.

67. *Q. Pseudo-suber*. Bastard Cork Oak. “Santi Viagg. 156. t. 4.” Spreng. *Antiq. Bot.* 16. t. 1. Willd. n. 60. Desfont. *Atlant.* v. 2. 348.—Leaves ovate-oblong, sinuated, hoary beneath; lobes numerous, pointed, entire. Bark fungous, cracked. Nut ovate. Calyx muricated, with lax, recurved, linear scales.—Native of the mountains of Tuscany, Spain, and Barbary. Desfontaines gathered it on mount Atlas, and the abbé Durand near Tangier. A tree fifty or sixty feet high, whose bark is corky, though less so than in *Q. Suber*, n. 33. Young branches downy or hoary, sometimes smooth, striated. Leaves deciduous, an inch and a half to three inches long, an inch or an inch and a half wide, acute; entire and slightly heart-shaped at the base; somewhat dilated upwards, and bordered with numerous, uniform, small, broad, acute, lobes or ferratures, separated by roundish sinuses; upper surface green and smooth; under glaucous, hoary, or somewhat downy. *Acorns* on short stalks, ovate, above an inch long, half covered by the cup, which is downy, and clothed with lax bluntish scales, recurved at their tips. Desfontaines says the leaves of young trees are deeply sinuated and ferrated; those of old ones more slightly so. In our specimens from Durand and Broussonet, the under side is scarcely downy,

except a dense fringe to the mid-rib. The transverse veins are more numerous, straight, and parallel, than in Sprengel’s plate. *Footstalks* rather above half an inch long, smooth or downy. *Acorns* nearly sessile, crowded about the ends of the branches. Yet we think it must be, at least, the plant of Desfontaines.

68. *Q. Aegilops*. Great-prickly-cupped Oak, or Velanida. Linn. Sp. Pl. 1414. Willd. n. 61. Ait. n. 20. Mill. Ic. t. 215. Olivier’s *Travels*, English edition, v. 2. 44. t. 13. (Q. orientalis, castaneæ folio, glauco recedatâ in cupulâ crassâ et squamulâ; Tourn. Cor. 40. Velani; Tourn. Voy. v. 1. 128. Glans Cerri; Dalech. Hist. v. 1. 7.)—Leaves ovate-oblong, with bristle-pointed tooth-like lobes; hoary beneath. Calyx of the fruit very large, hemispherical, with lanceolate, elongated, spreading scales.—Native of the Levant. Miller cultivated this Oak in 1731. The tree is not so lofty as some other species, nor is the wood much esteemed, or used, but in cabinet work. Leaves stalked, about three inches long, bright green; a little downy at the back; their edges, as in the last, very coarsely and acutely ferrated, rather than lobed, each tooth tipped with a bristly point. Acorn large, short, a little hollow at the top. Cup sessile, woody, two or three inches in diameter, from the projection of its numerous, oblong, thick scales. These cups are used, as well as the gall-nut, (see n. 40.) by the Orientals, Italians, and English, in dyeing, and are a considerable article of commerce. Tournefort says the modern Greeks call these acorns *Velani*, a corruption of *Bêran*, and the tree *Velanida*. The young acorns and cups, gathered from the tree, are much more esteemed than such as fall of themselves, when fully grown, and sell for twice the price of the latter. Dalechamp, Lobel, and Bauhin, mistake the unripe cup and acorn of this species, as belonging to *Q. Cerris*, n. 83.

SECT. 5.—Leaves sinuated, with blunt or pointless lobes.

69. *Q. alba*. White Oak. Linn. Sp. Pl. 1414. Willd. n. 62. Ait. n. 21. Pursh n. 29. Michaux Querc. n. 4. t. 5. (Q. alba virginiana; Catesb. Carol. v. 1. t. 21. f. 2.)—Leaves oblong, deeply pinnatifid; glaucous beneath; lobes linear-oblong, obtuse, entire, dilated upwards. Fruit stalked. Calyx depressed, warty.—Native of woods, on a fertile soil, from New England to Carolina, flowering in May; cultivated here in 1724, by Mr. Furber. Pursh says it is one of the most abundant and useful of its genus, in America, and grows in the middle States to an immense size. The adult leaves are nearly a span long, deeply and elegantly pinnatifid; tapering and acute at the base; gradually dilated upward; somewhat abrupt, though three-lobed, at the end; their lobes all entire, blunt, pointless, veiny; the upper surface green and shining; the under opaque and glaucous; not downy, as Linnæus and Willdenow define them, except perhaps when young. *Footstalks* stout, angular, half an inch, or more, in length. *Fruitstalks* twice as long, each bearing one or two, laterally sessile, ovate acorns, full an inch in length, with a short tuberculated cup. Michaux observes, that this Oak is preferred to all others in America, for building houses and ships; as well as for casks. The wood is so tough and pliable, as to serve for making baskets and brooms. The acorns are sweet, and Parkinson records that, in his time, the Indians were said to obtain from them, by boiling, an oil which they used in cookery. A supposed variety, called *repanda*, is figured by Michaux, in which the leaves are merely waved, not lobed; and green on both sides, though downy beneath. With this we are unacquainted, as also with Willdenow’s intermediate variety, called *pubescens*.

70. *Q. Esculus*. Italian, or Small-prickly-cupped Oak. Linn.

Linn. Sp. Pl. 1414. Willd. n. 63. Ait. n. 22. (*Phægus efculus*, mas et foemina; Dalech. Hist. 5.)—Leaves ovate-oblong, sinuated, smooth; paler beneath; segments bluntish; somewhat angular at the base. Fruit nearly sessile. Calyx lealy, hemispherical.—Native of the south of Europe. Cultivated by Miller in 1739; hardy in our gardens, flowering in May. *Aiton*. So little attention has been paid to this species by botanical writers, that we can find no certain description nor figure of it, except in Dalechamp. We even doubt whether the plant intended in the first edition of the Hortus Kewensis be the true one; yet this seems what Willdenow meant in his *Arbores*, or Baumzucht, though he does not cite either that work or Hort. Kew. in his Sp. Pl. What Linnæus briefly described in his Mantissa, 496, under the name of *Efculus*, seems to be *Cerris*, with which latter the description, copied by Willdenow, and the specific character extracted therefrom, well agree; but not at all with the original and authentic specimen of *Efculus* in the Linnæan herbarium. By this last alone can any one determine what Linnæus had in contemplation, when he wrote both editions of Species Plantarum, and we shall here describe the specimen. The branch is angular, furrowed, and smooth. Leaves scattered, aggregate at the top, from two to three inches long, and one and a half, at most, in breadth; smooth and shining above; paler, rather glaucous, and almost equally smooth, beneath, with finely reticulated veins; tapering at the very base, but just above it dilated, angular, and in some measure cordate, as Dalechamp's figures more distinctly shew. The summit is obtuse, and the margin cut unequally, on each side, into about five broad, blunt, entire, tooth-like serratures, or small lobes. Footstalks near an inch long, destitute of the long, linear, tufted, stipulaceous scales, or *ramenta*, found in *Aegilops*, *Cerris*, and *austriaca* hereafter mentioned. Young *acorns* axillary, nearly sessile, solitary or in pairs; the cups scaly, the size of small peas. Dalechamp represents the full-grown acorns about an inch long, embraced by an hemispherical scaly cup, about one-third that length. He says they are sweet and eatable, brought to table roasted by the Spaniards, as well as the rustic Italians, but sometimes found to affect the head, like darnel. The name *Efculus* is derived by etymologists from *esca*, food, and is commonly taken for the Beech-tree, ordinary readers of Virgil's Georgics not distinguishing one from the other; just as the *Cicada* of that poet has been vulgarly supposed the grasshopper. The Delphin edition of the Georgics has the above word *Aesculus*, as Linnæus has adopted it, unwarrantably, for the generic appellation of the Horse Chestnut; and the editors rightly observe, that some persons confound it with *Fagus*, the Beech. Our *Q. Efculus* is most probably the $\varphi\gamma\omicron$; of Dioscorides, which he expressly says is a kind of Oak. See FAGUS.

71. *Q. Robur*. Common British Oak. Linn. Sp. Pl. 1414. Sm. Fl. Brit. n. 1. Engl. Bot. t. 1342. Woodv. Med. Bot. t. 126. Mart. Rust. t. 10, var. pedunculata. (*Q. pedunculata*; Willd. n. 65. Ehrh. Arb. 77. Pl. Off. 168. Ait. n. 24. *Q. foemina*; Roth. Germ. v. 1. 408. v. 2. p. 2. 488. Fl. Dan. t. 1180. *Q. racemosa*; Lamarck Dict. v. 1. 715. *Q. cum longo pediculo*; Bauh. Pin. 420. *Q. hemeris*; Dalech. Hist. 4. Quercus; Fuchf. Hist. 229. Matth. Valgr. v. 1. 184. Duham. Arb. v. 2. t. 47. Tabern. Kreuterb. 1374. Oak-Tree; Hunt. Evel. Sylv. 69, with a plate.) Leaves deciduous, oblong, smooth, dilated upwards; sinuses rather acute; lobes obtuse. Stalks of the fruit elongated. Nut oblong.—Common in woods and hedges, throughout the more temperate parts of Europe, flowering in April. Nothing

is more general in the woods and hedges of Britain, nor more important as an object of national culture. The tree is the most ornamental to our plantations and landscapes; the wood more useful than any other, for its hardness, toughness, and durability; the bark peculiarly valuable for tanning. The leaves are alternate, with most, or scarcely any, footstalks, obovate-oblong, smooth, irregularly sinuated, with obtuse, rounded, pointless, entire lobes; their upper side of a rich shining green; the under paler, slightly glaucous; the base somewhat heart-shaped, or auricled. Clusters, or rather spikes, axillary; the male ones lax, pendulous, many-flowered, yellow; female on stalks an inch and a half or two inches long, composed of about three, laterally sessile, green flowers, surmounted by a naked elongation of the common stalk. Calyx of the male membranous, bell-shaped, mostly five-cleft, with about ten flaments; of the female coriaceous, scaly, downy, globose, at length hemispherical, woody, entire. Germen ovate. Style short, cylindrical. Stigmas three. Acorn elliptic-oblong, thrice the length of the cup. This being what Linnæus, as well as British botanists, always considered as *Quercus Robur*, the superior quality of its wood, no where better understood than here, entitling it, above all others, to that appellation, we cannot, on any account, submit to the errors of Willdenow, or any other writer, who has been pleased to change the name; and we feel equal surprise and regret that the excellent editors of the new Hort. Kew. should, in this case at least, have carried their implicit conformity so far. We trust they will hereafter correct themselves in this point, as well as in the barbarous name *Araucaria*, retained by Willdenow, contrary to all propriety, for DOMBEYA. See that article.

72. *Q. fessiliflora*. Sessile-fruited Oak. Salisb. Prodr. 392. Sm. Fl. Brit. n. 2. α . Engl. Bot. t. 1845. (*Q. Robur*; Willd. n. 64. Ait. n. 23. Lamarck Dict. v. 1. 717. Mart. Rust. t. 11, var. fessilis. *Q. fessilis*; Ehrh. Arb. 87. *Q. platyphyllos* mas et foemina; Dalech. Hist. 2, 3. *Q. latifolia* mas, quæ brevi pediculo est; Bauh. Pin. 419. Raii Syn. 440.)—Leaves on longish footstalks, deciduous, oblong, smooth; sinuses opposite, rather acute; lobes obtuse. Fruit sessile. Nut oblong.—Native of woods and hedges, in the temperate parts of Europe; rather less common in England than the preceding, flowering in April or May. Professor Martyn has rightly corrected Miller, who mentions the present as the common Oak of this country, and the former as rare. Why the German botanists, like Lamarck, take this for *Robur*, is difficult to understand, unless the measure originated in inattention to the qualities, as well as history, of the trees. The wood of our *fessiliflora*, in which name we gladly follow Mr. Salisbury, is of far less value than the true British Oak, and the importance of distinguishing the two species becomes, therefore, the more obvious. The leaves grow on longer footstalks, and are generally more equally and regularly pinnatifid. The female flowers, and the acorns, are almost perfectly sessile. In English Botany four stigmas are delineated; but we know not how far that character, which would be an excellent one, is constant.

73. *Q. pubescens*. Downy-waved-leaved Oak. Willd. n. 66, excluding the reference to Fl. Brit. (*Q. Robur lanuginosa*; Lamarck Dict. v. 1. 717. *Robur prima*; Clus. Hist. v. 1. 18.)—Leaves oblong-obovate, stalked, sinuated; downy beneath; lobes obtuse, angular, wavy; somewhat heart-shaped and unequal at the base. Fruit nearly sessile.—Native of France, Austria, Hungary, Tartary, and of the Val d'Aoste, Piedmont, in which last place it was gathered by Mr. Davall. We have seen a tree of

this species, growing on the north lawn at Holkham, Norfolk, the seat of Mr. Coke, where it was planted by his ancestor, the earl of Leicester; but no British writer seems acquainted with the species in question, though unquestionably distinct. Willdenow justly says it is like his *Robur*, our *fessilisflora*, but abundantly different, being of more humble stature, with smaller leaves, downy beneath, very hoary and white in the spring, somewhat heart-shaped at the base, and with smaller fruit. To this we would add, the leaves are remarkably undulated, especially in drying, and their upper surface is more or less besprinkled with very minute, scattered, starry hairs. The fruit in Mr. Davall's specimens is quite sessile, either solitary, or in one instance accompanied by two abortive ones; in those from Holkham the female flowers are more or less elevated, three together, on a thick downy stalk. Hence perhaps, Willdenow terms the fruit subsessile. The scales of the cup in both are downy, thin, flat, and closely imbricated.

A variety of this, with deeper segments, and of more humble growth, is *Robur tertia*, Clus. Hist. v. 1. 18. f. 1. Of this a specimen, erroneously named *Cerris*, and pinned to *Ejculus*, n. 70, above described, is preserved in the Linnean herbarium.

74. *Q. atro-virens*. Durmast Oak. Mart. Rust. t. 12. (*Q. fessilisflora* β; Sm. Fl. Brit. 1027. *Q. pubescens*; Ait. n. 25, but not of Willdenow. *Q. Robur nigra*; Lamarck Dict. v. 1. 717. *Chêne noir*; Secondat du chêne. 3. t. 5?)—Leaves elliptic-oblong, stalked, sinuated; downy and hoary beneath; lobes numerous, obtuse, even, and entire; base equal. Fruit sessile.—Native of France and the south of England, flowering in April and May. Professor Martyn had his specimens from the New Forest, Hampshire, where it is known by the name of the Durmast Oak. The whole tree is well described by him as having much the air of a chestnut, and being of freer growth than the true *Robur*; the bark lighter coloured and smoother; the wood not so strong, nor of so firm a texture. The leaves are less deeply, but more copiously, sinuated, with five, six, or seven short lobes at each side; the under surface downy, and of a hoary grey, with purplish ribs. The foliage appears later than in either of our common Oaks, and lasts longer, sometimes the whole winter. *Acorns* sessile, rather large. Lamarck's description, indicated above, accords exactly with our English plant, to which also, we presume, the synonym of Secondat must belong, though we have not been able to consult his book. A more accurate study of this genus has led us to agree with our departed friend Willdenow, in distinguishing the Durmast Oak from our *fessilisflora*, but he errs in referring it to his *pubescens*, and has led Mr. Aiton into the same mistake. Its leaves are more oblong, less deeply sinuated, flat, not undulated; the under side whiter, with coloured veins. The fruit larger, and more decidedly sessile.

75. *Q. pyrenaica*. Pyrenean Oak. Willd. n. 67.—“Leaves oblong, pinnatifid, stalked; downy beneath; somewhat heart-shaped and unequal at the base; lobes obtuse, slightly toothed. Fruit stalked.”—Native of the Pyrenees. The leaves are larger than in *fessilisflora*, stalked, deeply sinuated; densely downy underneath. Footstalks downy. *Acorns* four, sessile on one common elongated stalk. It differs abundantly from *pubescens*, in having much larger leaves, sinuated in a pinnatifid manner, very downy beneath; and stalked fruit. Such is Willdenow's account. We have seen no specimen. Can this be our above-mentioned variety of *pubescens*?

76. *Q. faginea*. Beech Oak. Lamarck Dict. v. 1. 725. Willd. n. 68. (*Phellodrys alba angustifolia*, folio

ferrato; Dalech. Hist. 25.)—Leaves on short downy stalks, obovate, with numerous, uniform, shallow lobes; downy beneath; somewhat heart-shaped and unequal at the base. Fruit sessile.—Native of Spain and the south of France. Leaves small, an inch and half long, deciduous, obovate, very slightly sinuated, or, more properly speaking, coarsely toothed, the lobes being very short, equal, and obtuse; the upper side polished and smooth; the under white and downy. Footstalks downy. Fruit sessile. Willdenow. In the Linnean herbarium are specimens, gathered by Baron Allstroemer in Spain, which answer extremely well to the above description, and not amiss to the figure of Dalechamp, which Lamarck cites with hesitation. In these however, the lobes, or teeth, are acute, and the upper surface covered with minute starry hairs. There are also long, linear, recurved, ramentaceous stipules, that are soon deciduous. We do not scruple to consider this as Lamarck's plant at least, and probably Willdenow's.

77. *Q. lobata*. Round-lobed Mexican Oak. Willd. n. 70. Nec in Annal. Scient. Nat. v. 3. 277. Fisch. Misc. Hist. v. 1. 116. Willd.—“Leaves obovate-wedge-shaped, sinuated, smooth; lobes toothed.”—Native of New Spain. Branches furrowed, alternate. Leaves four inches long, two inches and a half wide, smooth, alternate, orbicular towards the extremity; wedge-shaped at the lower part; sinuated; the lobes rounded, obtuse, toothed. Footstalks slender, three or four lines in length. Nec.

78. *Q. obtusiflora*. Blunt-lobed Iron Oak. Michaux Querc. n. 1. t. 1. Pursh n. 25. (*Q. stellata*; Willd. n. 71. Ait. n. 26. Wangenh. Amer. 78. t. 6. f. 15.)—Leaves oblong, sinuated, roughish on both sides; lobes obtuse; the upper ones dilated, abrupt, slightly divided. Calyx of the fruit hemispherical.—Found in most of the upland forests, from Canada to Florida, blossoming in May. The tree is fifty or sixty feet high, spreading, its timber of great value for ship-building. The whiteness of the bark, as in *Q. alba*, causes both these species to be called White Oak by the Americans, who nevertheless know how to distinguish their timber. The leaves of the present are roughish beneath, with minute rusty hairs, not hoary; and their upper surface appears to partake occasionally, if not always, of the same sort of pubescence. Their length is from three to five inches; the base wedge-shaped, spreading upwards into two smaller, opposite, rounded lobes, beyond which the leaf dilates, suddenly and widely, into a pair of broad, slightly cloven, or emarginate, lobes, and, after another sudden contraction, ends in a terminal three-cleft one. The margin is entire throughout. Footstalks short, downy. *Acorns* three or four on a short stalk, of a middling size, scarcely exceeding our British Oaks, elliptical, about half enclosed in the scaly cup.

79. *Q. lyrata*. Over-cup Lyrate Oak, Swamp-post, or Water White Oak. Walt. Carol. 235. Willd. n. 72. Ait. n. 27. Pursh n. 28. Michaux Querc. n. 3. t. 4.—Leaves oblong, deeply sinuated, smooth; much contracted in the middle; lobes acute; the upper ones dilated, angular, and abrupt. Calyx of the fruit globose, muricated, nearly covering the nut.—Native of swamps, from Carolina to Florida, and on the Mississippi; flowering in May. Pursh. Michaux says, that though he always found this species in watery places, its growth, in a dry surferous-ground, exceeded that of most other species planted with it. He gives fifty or sixty feet as the height of the tree; Pursh from eight to fifteen only. The smooth fine-green leaves have more acutely-angular lobes than the foregoing, and are remarkably contracted about the middle. *Acorn* globose, nearly covered by the globular prickly cup.

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80. *Q. macrocarpa*. Large-fruited Oak, or Over-cup White Oak. Willd. n. 73. Pursh n. 26. Michaux. Querc. n. 2. t. 2, 3. Leaves oblong, lyrate; downy beneath; terminal lobe very large, three-cleft, sinuated. Calyx of the fruit hemispherical, scaly, fringed with bristles.—Found on dry slate or limestone hills, in all the countries to the west of the Alleghany mountains, flowering in May. A large tree, whose wood, according to Pursh and Michaux, is very excellent. The bark of the young branches is corky. In wet situations the whole plant languishes, and becomes covered with lichens. The leaves are a foot long, more truly and precisely lyrate than those of the last; but the specific name of the present is excellent, the *acorns* being larger than those of any other known American species. Their form is oval, their length two inches, and they are half covered by the cup, several rows of whose broad scales end in long bristles, making a rigid fringe.

81. *Q. oliviformis*. Olive-shaped Mossy-cup Oak. "Michaux Arb. v. 2. 32. t. 2." Pursh n. 27.—"Leaves oblong, smooth; glaucous beneath; deeply and unequally pinnatifid. Fruit elliptic-ovate. Calyx cup-shaped, fringed."—Observed by Michaux on the banks of Hudson's river, and in the western parts of New York; by Pursh in Pennsylvania and Virginia, on iron-ore hills; flowering in May. This is described as a large tree; the foliage handsome, somewhat resembling that of the last. We have not examined either a specimen or figure. Willdenow does not mention this species.

82. *Q. crinita*. Hairy-cupped Oak. Lamarck Dict. v. 1. 718, α . Olivier's Travels, English edition, v. 2. 5. t. 12. (*Q. Tournesfortii*; Willd. n. 74. *Q. orientalis latifolia*, foliis ad costam pulchrè incisis, glande maximâ, cupulâ crinitâ; Tourn. Cor. 40. Voy. v. 2. 172.)—Leaves on long stalks, oblong, deeply pinnatifid; downy beneath; lobes lanceolate, bluntish, nearly entire. Calyx of the fruit hemispherical, downy, bristly.—Gathered by Tournefort in vallies and plains near Tocat, in Armenia. Olivier says it is met with throughout great part of Asia Minor and Syria. The timber is brought to the arsenal of Constantinople, from the southern shores of the Black Sea, and is also most commonly employed for the frame-work of houses. The tree grows to a considerable height, and furnishes excellent wood. This author, who takes the tree in question for *Q. Cerris* of Linnaeus, may, possibly, confound the real *Cerris* along with it, as Lamarck, though not without scruple, has combined them. Olivier's plate, however, very clearly represents the above plant of Tournefort; and Lamarck's excellent definition of the same, as variety α of his *crinita*, is abundantly sufficient to stamp it a species. "Leaves very softly villous, deeply pinnatifid; their segments oblong, nearly simple, obtuse, somewhat pectinate," (or parallel.) He says it is reported to grow wild in the province of Angoumois, and is a tree of handsome aspect, remarkable for its soft, downy, broad leaves, cut very deeply into large segments, blunt at their extremity, often simple, sometimes furnished with a few angles, or short lobes, at their posterior margin. *Acorns* sessile, their cup bristly, as in the Burgundy Oak (*Cerris*). Tournefort's specimens agree with the Angoumois Oak, as it is called, seen by Lamarck in a cultivated state at Godonvillier. We have seen no specimen, but the above accounts are sufficiently clear to admit of no doubt. Olivier's plate represents the leaves three or four inches in length, their segments about an inch long, almost all simple and undivided, bluntish, entire, more or less distant, each making an angle with the narrow linear border of the main rib. Footstalks slender, an

inch, more or less, in length, apparently smooth. *Acorns* lateral, about an inch long, elliptical, obtuse, solitary, on short simple stalks; the cups beset with numerous soft taper bristles, divaricated upwards and downwards, near half an inch long. Nothing is exhibited, or described, concerning the *stipulas*, which are very remarkable in the two following species.

83. *Q. Cerris*. Turkey Oak. Linn. Sp. Pl. 1415. Willd. n. 75. Ait. n. 28, γ . (*Q. crinita* α et β ; Lamarck Dict. v. 1. 718. *Q. haliphloos*; Juss. in Hort. Paris. *Q. burgundica*, calyce hispido; Bauh. Pin. 420. *Cerris* Plinii, majore glande; Lob. Ic. v. 2. 156. Dod. Pempt. 831. Ger. Em. 1345. *Cerrus*; Dalech. Hist. v. 1. 6, good.)—Leaves on very short stalks, oblong, deeply and unequally pinnatifid; hairy beneath; lobes lanceolate, acute, somewhat angular. *Stipulas* longer than the footstalks. Calyx of the fruit hemispherical, bristly.—Native of France, Italy, and the Levant. Sometimes cultivated in England, but not commonly. This is a tall handsome tree, whose synonyms are much confounded by old writers with *Q. Aegilops*, n. 68, and by more recent botanists with the following. Its leaves are deeply pinnatifid in the manner of the foregoing; more or less unequally; but the lobes are more acute, pointed, and most generally angular, sometimes remarkably lobed or compound. The under side differs essentially, in being neither downy nor hoary, but rough with minute, scattered, tawny, bristly hairs; the upper, which is of a darker green, and rather shining, is also occasionally roughish to the touch. Footstalks rough, thick, hardly a quarter of an inch, sometimes not a line, in length. *Stipulas* linear, acute, downy, from half an inch to an inch long, permanent, accompanied by an axillary tuft of similar, but smaller, scales. The *acorns* we have not seen. They are represented sessile, two or three together, large, oblong, with an hemispherical cup, which is shaggy with long bristles, projecting in every direction. They are said to be peculiarly bitter and austere.

Lamarck asserts, from his own observation, that the *Q. orientalis latifolia*, glande maximâ, cupulâ crinitâ, Tourn. Cor. 40, scarcely differs in any respect from this. If so, the term *latifolia* is not happily applied, unless Tournefort had also noticed, as in our last, the deep divisions of the leaves, which are full as remarkable in the present species.

84. *Q. austriaca*. Austrian Oak. Willd. n. 76. (*Q. Cerris*; Hoff. Syn. 520, α and β . Ait. n. 28. *Q. crinita* γ , *cerris* Linn.; Lamarck. Dict. v. 1. 718. *Q. calyce hispido*, glande minore; Bauh. Pin. 420. *Cerrus*; Clus. Hill. v. 1. 20, excellent. *Cerri minoris ramulus cum flore*; Ger. Em. 1346, with Clusius's figure. *Cerris* Plinii minore glande; Lob. Ic. v. 2. 156. Ger. Em. 1345. *Aegilops* minore glande; Dod. Pempt. 831. *Haliphloeos*, *Cerrus foemina*; Dalech. Hist. v. 1. 7.)—Leaves on longish stalks, ovate-oblong, slightly but copiously sinuated; downy and hoary beneath; lobes short, ovate, acute, entire. *Stipulas* shorter than the footstalks. Calyx of the fruit hemispherical, bristly.—Native of Austria, Hungary, Carniola, Italy, and other parts of the south of Europe, in stony mountainous places. It occurs not unfrequently in plantations of exotic trees, both in France and England, being generally mistaken for *Q. Cerris*, from which nothing can be more certainly distinct. This tree is taller than the Common Oak, *Q. Robur*, and in favourable situations rises perpendicularly to a considerable height, as Clusius described it, though Lamarck says it is smaller, less handsome, more twisted and knotty, than the last, as well as often hollow. The wood is whiter, softer, and less valuable, than *Q. Robur*; the bark grey, tolerably even. Branches forming a round

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a round and compact head. *Leaves* two or three inches long, acute, generally rounded and a little unequal at the base; their upper surface of a fine shining green, and nearly smooth; the under whitish, clothed with fine dense down; the margin cut, at each side, into four, five, or six, tolerably regular, rounded or ovate, acute, pointed, entire lobes, more or less deep, separated by round sinuses; the disk of the leaf being left entire, of a considerable width. *Footstalks* near an inch long, downy. *Stipules* as in the foregoing, but smaller and shorter, usually about half the length of the footstalks. *Acorns* like those of the last, but smaller. The figures of Lobel, Dodonæus, and Ger. Em. 1345, do not well represent the leaves of this species, or indeed of the former: that of Clusius, adopted by the editor of Gerarde, in p. 1346, is perfectly correct. The cuts of Dalechamp, both of one and the other, are sufficiently expressive, and very correct as to the footstalks. The lobes of neither of these species are quite pointless, but rather more pointed, as well as acute, than those of *Esculus*, n. 70.

We have thus added eight species of *Quercus* to Willdenow's list. Those botanists who may take the trouble of following us with attention, will perceive that this valuable genus still requires elucidation, particularly with respect to the European, and, above all, the oriental kinds; some of which last, barely indicated by authors, we have been obliged to leave unexplained. Of the most common and important species, *Q. Robur*, we have seen in Mr. Coke's woods at Holkham, some striking varieties, at least, whose distinctions and qualities are well worthy of examination. Two of these have shorter *flower-stalks* than the common *Robur*, and one of them is three weeks earlier in coming into leaf than the other. The *footstalks* of both are longer than is usual in *Robur*. How far a difference of quality in the wood may accompany these botanical distinctions, we must refer to the inquiries of those who are interested in, and have the means of investigating, so important a subject, which is indeed of the first economical, and even national, consequence. It is much to be wished that the species of the Norway Oak, so valuable for floors, on account of its straightness, and freedom from knots, could be determined. Perhaps these circumstances are owing to its being drawn up straight, with few branches, in its close native forests, and therefore it may not be specifically different from one or other of our own species. Michaux, and other writers on the American Oaks, have taught us, that the pubescence of the leaves in this genus is of more specific importance than had previously been supposed, and we therefore have paid the more regard to it in discriminating some of the European kinds. The *flowers*, male and female, appear still to demand more precise investigation and comparison, than they have any where received. S.

QUERCUS, in *Gardening*, furnishes plants of the forest, deciduous, evergreen, ornamental tree-kinds, of which the species cultivated are, the common oak-tree (*Q. robur*); the willow-leaved oak-tree (*Q. phellos*); the chestnut-leaved oak-tree (*Q. prinus*); the black oak-tree (*Q. nigra*); the red oak-tree (*Q. rubra*); the white oak-tree (*Q. alba*); the Italian or small prickly-cupped oak-tree (*Q. esculus*); the great prickly-cupped oak-tree (*Q. ægilops*); the Turkey oak-tree (*Q. cerris*); the evergreen or holm oak-tree (*Q. ilex*); the holly-leaved evergreen oak-tree (*Q. græmuntia*); the cork-barked oak, or cork tree (*Q. suber*); and the kermes oak-tree (*Q. coccifera*).

Of the first there are several varieties; as with the acorns on long peduncles. This is found in the wilds of Kent and Suffex, where there are many large trees. The leaves are

not so deeply sinuated, nor are they so irregular as in the common sort, but the indentures are opposite; they have scarcely any footstalks, but sit close to the branches; but the acorns stand upon very long footstalks. The timber of this sort is accounted better than that of the common oak, and the trees have a better appearance.

The broad-leaved evergreen oak, which grows upon the Apennines, and also in Suabia and Portugal. The leaves are broader, and not so deeply sinuated as those of the common oak; they are of a lighter green on their upper side, and pale on their under; have very short footstalks, and their points are obtuse; the acorns have very long footstalks, which frequently sustain three or four in a cluster.

The dwarf oak, which grows in the south of France and Italy, and is a low bushy oak, rises but six or seven feet high, sending out many slender branches the whole length. The leaves are oblong, and obtusely indented, about three inches long, and an inch and a half broad, standing upon slender footstalks; the acorns small, growing in clusters.

There are also many other varieties of common oak, which dealers in timber and woodmen distinguish by their use, qualities, and accidents, and to which they give different names; but these being merely local, and not founded on permanent characters, it is difficult to ascertain them.

In the second species they distinguish two sorts; one of which is called the Highland willow oak, and grows upon poor dry land; the leaves are of a pale green, and entire, shaped like those of the willow tree; the acorns are very small, but have pretty large cups. The other grows in low moist land, and rises to a much greater height; the leaves are larger and narrower, but the acorns are of the same size and shape. It is suggested, as probable, that their difference may be owing to the soil in which they grow. Martyn observes, that the latter becomes a large timber tree, and that there are said to be several varieties of it.

The third species has seemingly two varieties, one of which grows to a much larger tree than the other; but this may be occasioned by the soil, for the largest trees grow in rich low lands, where they become bigger than any of the North American oaks. The wood is not of a very fine grain, but is very serviceable; the bark is grey and scaly; the leaves are five or six inches long, and two inches and a half broad in the middle, indented on the edges with many transverse veins running from the midrib to the borders; they are of a bright green, and so nearly resemble those of the chestnut tree as scarcely to be distinguished from it. The acorns are very large, and their cups are short. The leaves of the other variety are not so large, nor so strongly veined; and the acorns are smaller, and a little longer. The different varieties are distinguished by the form of their leaves, which in the one is ovate, and in the other oblong.

The fifth sort has several varieties.

And in the ninth sort there are several varieties.

The tenth species has likewise several varieties, differing greatly in the size and shape of their leaves; but these will all arise from acorns of the same tree: even the lower and upper branches have very frequently leaves very different in size and shape; those on the lower branches being much broader, rounder, and their edges indented and set with prickles; but those on the upper long, narrow, and entire. The leaves are from three to four inches long, and an inch broad near the base, gradually lessening to a point; they are of a lucid green on their upper side, but whitish and downy on their under, and do not fall till they are thrust

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off by young leaves in the spring. The acorns are smaller than those of the common oak, but of the same shape.

The twelfth species has also two or three varieties; one with a broad leaf, a second with a narrow leaf, both evergreen; and one or two which cast their leaves in autumn: but the broad-leaved evergreen is the most common. The leaves of this are entire, about two inches long, and an inch and quarter broad, with a little down on their under sides, on very short footstalks: these leaves continue green through the winter till the middle of May, when they generally fall off just before the new leaves come out, so that the trees are often almost bare for a short time. The acorns are very like those of the common oak.

The exterior bark forms the cork, which is taken from the tree every eight or ten years; but there is an interior bark which nourishes them, so that stripping off the outer bark is so far from injuring the trees, that it is necessary to continue them: for, when the bark is not taken off, they seldom last longer than 50 or 60 years in health; whereas trees which are barked every eight or ten years will live 150 years, or more. The bark of a young tree is porous, and good for little: however, it is necessary to take it off, when the trees are twelve or fifteen years old, for without this the bark will never be good. After eight or ten years, the bark will be fit to take off again; but this second peeling is of little use. At the third peeling, the bark will be in perfection, and will continue so for 150 years; as the best cork is taken from old trees. The time for stripping the bark is in July, when the second sap flows plentifully: the operation is performed with an instrument like that which is used for dibarking the oak.

It is from the last species they collect the kermes, or scarlet grain, a little red gall, occasioned by the puncture of an insect called *coccus ilicis*. With this the ancients used to dye cloth of a beautiful colour.

Method of Culture.—These trees are all capable of being raised from the seed or acorns, which, in the common oak, should be gathered in autumn when quite ripe, just as they drop from the trees; but those of most of the foreign oaks are generally procured from abroad, and sold by the seedmen.

All the sorts should be sown as soon after they are obtained as possible, as they are apt to sprout if they remain long out of the ground; and for their reception, a spot of light ground in the nursery should be prepared by digging or ploughing, dividing it into four feet wide beds, in which the acorns should be sown, either in drills, two inches deep, in five or six rows lengthwise of the bed; or rake the mould off the bed, the depth of two inches, into the alleys; then sowing the acorns all over the surface, about two or three inches apart, press them down with the spade, and spread the earth evenly over them two inches thick. When they come up in the spring, they should have occasional waterings and weeding; and when the plants are one or two years old, it is proper to plant them out in nursery-rows: this may be done in autumn, winter, or early in the spring, taking them carefully up out of the seed-bed, shortening their perpendicular tap-roots, and trimming off any lateral shoots from the stem, leaving their top perfectly entire; then planting them in lines two feet and a half asunder, and fifteen or eighteen inches in the rows, where they should stand, with the usual nursery care, till of a proper size for final planting out either as forest trees, or for ornament, training them up as full standards, with clean straight stems, and with their tops still entire.

But in raising the striped-leaved varieties of the common oak, and any particular variety of the other species, it

should be by grafting, (as they will not continue the same from seed,) which should be performed upon any kind of oakling stocks raised from the acorns, and trained for standards, as in other kinds.

With respect to the final planting out, it may be performed in all sorts of deciduous oaks any time in open settled weather, from November till February or March; and in the evergreen kinds in October, November, or the spring; and in a mild open season in any of the winter months.

When the trees of all the sorts are from about three or four to six feet stature, they are proper for being planted out for good; though, as forest or timber trees, it is better to plant them out finally while they are quite young, as from two to three or four feet in height; or when planted immediately from the seed-bed, where they are to remain, it may be advantageous, as the very young oaks root more freely than older trees, and take a freer growth. Those designed as forest or timber trees should be planted in large open tracts of ground, to form woods, placing them in rows only from four or five to ten feet asunder, and from two or three to five or six feet in the rows, to allow for a gradual thinning. But perhaps the best method of all for raising them, as timber trees, is from the seed, by sowing or setting the acorns. See PLANTATION and PLANTING.

Sometimes, indeed, large plantations of these trees, for woods, are raised by sowing the acorns at once in the places where they are to remain; it being generally found that the trees raised at once from the acorn, from their not being checked, much outstrip the transplanted trees in their growth. The method of performing it is this: the ground being prepared by good ploughing and harrowing in the autumn, having procured a proper quantity of acorns, draw drills across the ground four feet asunder, and two inches deep, dropping the acorns into them six or eight inches asunder, allowing for sowing and thinning, covering them in evenly with the earth the depth of the drills; or, instead of drilling them in, they may be planted with a dibble the same depth and distance.

The general management of these trees in woods, or timber plantations, is the same as directed for forest trees in general. See PLANTATION.

All the above sorts of trees may be employed to diversify large ornamental plantations in out-grounds, and in forming clumps in spacious lawns, parks, and other extensive open spaces: the evergreen kinds, in particular, have great merit for all ornamental purposes in pleasure-grounds and plantations. And all the larger growing kinds, both deciduous and evergreens, are highly valuable as forest trees for timber; but the first sort claims precedence as a timber tree, for its prodigious height and bulk, and superior worth of the wood.

In planting any of the species for ornament or variety in large pleasure-grounds, some may be disposed in assemblage in any continued plantation, some in clumps, and others singly.

All the different sorts of the oak will succeed in any soil of a middling quality, where the exposure is not unfavourable; but to the most advantage, where the land is of a loamy nature: they, however, thrive tolerably in those soils which are of a gravelly, sandy, or clayey description.

Besides the great value of these sorts of trees for the utility and durability of their wood, as timber, for the purposes of ship-building, house-building in some parts, park-paling, posts, railings, and a variety of other strong uses; they, in many of the kinds, afford considerable additional advantage

advantage by their produce in bark, for the use of the tanners and cork-cutters, in tanning leather, and being made into corks; after the former of which, it is also much employed in gardening, for the forming of bark hot-beds, in raising tender hot-house exotic plants: as well as in their annual crops of acorns, as an excellent food for the keeping and fattening of swine, deer, and some other animals.

QUERCUS, in *Planting*, a classical term sometimes applied to the oak-tree in nursery collections, intended for this sort of application. See OAK-Tree.

QUERCUS *Marina*, the *Sea-Oak*, in *Botany*, the name of one of the broad-leaved dichotomous sea-fucuses.

It is not agreed, among the late botanists, what was the sea-oak of Theophrastus; and the most ancient botanists, Clusius and Cæsalpinus, suppose it to have been a species of the shrubby coralline; but that seems by no means to have been the case, since Theophrastus says his sea-oak had a long, thick, and fleshy leaf, whence we may much more naturally conclude it to have been of the fucus class.

QUERCY, in *Geography*, a province of France before the revolution, in the government of Guienne; bordered on the E. by Rouergue and Auvergne, on the S. by Upper Languedoc, on the W. by Perigord and Agenois, and on the N. by Limosin: it contained two bishoprics, *viz.* Cahors and Montauban. The air is good, and the land is fertile: its capital was Cahors. It now constitutes the department of the Lot.

QUEREIVA, in *Ornithology*, the purple-throated chat-terer of Latham, a species of Ampelis.

QUERELA, QUARREL, in *Law*, denotes an action, or declaration, preferred in any court of justice. See QUARREL.

In an action where the plaintiff is called *querens*, *i. e.* complainant, his brief, complaint, or declaration, is called *querela*.

QUERELA *Audita*. See AUDITA.

QUERELA *coram rege et concilio*, a writ by which one is called to justify a complaint of a trespass made to the king himself, before the king and his council.

QUERELA *Duplex*. See DOUBLE Quarrel.

QUERELA, *Ex gravi*. See EX GRAVI, &c.

QUERENGHI, ANTONIO, in *Biography*, a man of letters, was born at Padua in 1546. He displayed, at an early period of his life, a decided attachment to literature; he wrote verses before he was twelve years of age, and soon became distinguished by his deep knowledge of the languages, civil laws, and the philosophy that was taught at that period. For some time he applied himself to theology, and made considerable proficiency in it. He next went to Rome, where he entered into the service of several cardinals, and at length became secretary of the sacred college, in which capacity he was present at the election of five popes. Clement VIII. conferred upon him the canonry of Padua, which occasioned him to reside in that city, but he returned to Rome in the pontificate of Paul V., by whom he was promoted to some offices of trust. He died at Rome in 1633, at the age of 87. He was a man of various and extensive literature, and was much regarded by the learned of the time in which he flourished. His writings were numerous, and comprehended the sciences and polite literature. He is chiefly known to posterity by his poems, which are correct and elegant, but by no means animated. Moreri.

QUERETANO, in *Geography*, a town of Mexico; 80 miles N.N.W. of Mexico. N. lat. 20° 25'. W. long. 101° 36'.

QUERFAA, in the *Materia Medica of the Arabians*, a

name given by Avicenna and others to cinnamon, when gathered with the wood of the young branches.

It was a common practice in the early times not to strip the small bark from medicinal trees, but to cut off the little boughs, and use the bark and wood together. This the Greeks called *xylo cinnamomum*, or woody cinnamon; and the Arabians, *querfaa*, *querje*, or *kerfe*.

QUERFURT, in *Geography*, a town of Saxony, situated on the little river Weite, inconsiderable in itself, but having large suburbs; the number of houses is estimated at upwards of 500. The old castle belonging to it stands on a hill, and it has likewise a superintendency; 16 miles S.W. of Halle. N. lat. 51° 23'. E. long. 11° 45'.

QUERIA, in *Botany*, received that name from Loeßing and Linnæus, in compliment to Don Joseph Quer y Martinez, a Spanish surgeon, who though he wrote against the Linnæan system, and even the sexes of plants, contending that palm-trees ripen fruit without impregnation, was an assiduous practical botanist. He published a Spanish Flora, in his native tongue, consisting of four volumes quarto, of which the first three appeared in 1762, and the fourth in 1764. A fifth and sixth were added by Ortega in 1784. Quer was professor of botany in the royal garden at Madrid, and died in 1764, aged 69. He wrote also on the *Uvi Urfs*, (which he removes from the genus *Arbutus*,) as a specific in calculous complaints; and on the medical use of *Cicuta*.—See Haller's Bibl. Bot. v. 2. 516. and Dryandr. Bibl. Banks.—Linn. Gen. 43. Schreb. 58. Willd. Sp. Pl. v. 1. 493. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 1. 185. Juss. 300. Lamarck Illustr. t. 52. Gært. t. 128?—Class and order, *Triandria Trigynia*. Nat. Ord. *Caryophyllea*, Linn. Juss.

Gen. Ch. *Cal.* Perianth inferior, of five erect, oblong, acute, permanent leaves; the outermost recurved. *Cor.* none. *Stam.* Filaments three, capillary, short; anthers roundish. *Pist.* Germen superior, ovate; styles three, the length of the stamens; stigmas simple. *Peric.* Capsule roundish, of one cell, with three valves. *Seed* solitary, roundish, compressed.

Ess. Ch. Calyx of five leaves. Corolla none. Capsule of one cell, with one seed.

Obs. Linnæus remarks, that this genus differs evidently from MINUARTIA, see that article, in having a solitary seed. *Q. canadensis*, figured by Gærtner, is removed hence by Michaux to his genus *Anychia*, which belongs to a different natural order, the *Holeraceæ* of Linnæus, and has a capsule destitute of valves. Gærtner indicates its close affinity, except in number of stamens, to his PARONYCHIA, see that article. Michaux and Pursh assert that its stamens vary from two to five.

1. *Q. hispanica*. Spanish Queria. Linn. Sp. Pl. 132. Willd. n. 1. Ait. n. 1. Loeß. It. 48. 83. Quer. Fl. Espan. v. 6. 667. t. 15. f. 2.—Flowers crowded into a tuft. —Native of sandy grounds in Spain. Seeds were sent to Kew, in 1800, by the late marchioness of Bute. The plant is a diminutive hardy annual, flowering most part of the summer. *Root* fibrous. *Whole herb* whitish, brittle, one or two inches high, with several leafy, round, rather downy, slightly reddish *stems*. *Leaves* opposite, sessile, awl-shaped, three-ribbed, curved to one side, rather longer than the joints of the stem. *Head of flowers* obscurely quadrangular, densely dichotomous, easily breaking off from the stem. *Bractææ* opposite, awl-shaped, recurved, and hooked, easily catching hold of the coats of animals. *Flowers* very minute.

2. *Q. canadensis*. Canadian Queria. Linn. Sp. Pl. 132. Willd. n. 2. Ait. n. 2. Gært. v. 2. 217. t. 128. f. 10. Gron. Virg. ed. 2. 16. (Mollugo foliis oppositis, stipulis quaternis,

quaternis, caule dichotomo; Gron. Virg. ed. 1. 14. Anychia dichotoma; Michaux Boreal-Amer. v. 1. 113. Pursh v. 1. 176.)—Flowers solitary, stem forked.—Native of dry lime-stone hills, from New York to Kentucky, flowering from June to August. Introduced at Kew, in 1806, by his royal highness the duke of Kent, according to Mr. Aiton, who marks it as a hardy biennial. Linnæus and others make it perennial; which the appearance of the plant contradicts. The root is small, tapering, with a few pale fibres. Stem solitary, near a span high, round, jointed, smooth, reddish, erect, leafy; simple below; repeatedly subdivided, forked and spreading, above; the branches divaricated, capillary, leafy, many-flowered. Leaves opposite, on short stalks, obovate, entire, smooth, from one-fourth to three-fourths of an inch long, covered on both sides with reddish dots, which become prominent as the leaves dry. These dots, Linnæus says, disappear by culture. Stipules two at each side, membranous, acute. Flowers very small, axillary or lateral, green, on short stalks. Calyx-leaves concave, or vaulted, below the point. Stamens, according to Michaux, always five in the wild plant; in the cultivated one often but two. Linnæus justly points out the resemblance of this herb, at first sight, to *Linum catharticum*; but its strict affinity to *Ilecebrum*, *Polygonum*, &c. is far more striking, as well as its total unlikeness to the original *Queria*; so that there can be no doubt of the necessity of removing it from the present genus, whether the *Anychia* of Michaux be permanently established or not.

3. *Q. trichotoma*. Three-forked *Queria*. Thunb. in Transf. of the Linn. Soc. v. 2. 329. Willd. n. 3. (*Rubia spicis ternis*; Thunb. Jap. 357.)—Flowers racemose. Stem triply forked.—Native of Japan.—Herb with widely spreading, thread-shaped, smooth branches. Leaves opposite, on very short stalks, ovate, acute, nearly entire, smooth, widely spreading, as long as the finger nail. Clusters axillary, three; two opposite, one terminal, composed of three or four pair of opposite, minute, deciduous flowers. To this description Thunberg adds—"Corolla cylindrical. Fruit inferior, oblong, smooth."—This must be altogether a mistake, if the plant has any pretensions to be reckoned a *Queria*. Having seen no specimen, we leave the matter as we find it. The genus before us must probably depend on the first species only; and whether the character of the solitary seed, by which alone it stands distinguished from *Mimartia*, be sufficient, there being the strictest conformity in habit and every other particular, we feel much inclined to doubt.

QUERIGUT, in *Geography*, a town of France, in the department of the Ariège, and chief place of a canton, in the district of Foix; 27 miles S.E. of Tarascon. The place contains 809, and the canton 2483 inhabitants, on a territory of 132½ kilometres, in seven communes.

QUERIMBA, a cluster of islands, deriving its name from the principal, in the Indian sea, near the coast of Africa; fertile in dates, oranges, grapes, and other fruits and legumes. The pastures feed great numbers of large and small cattle, and the coasts abound with fish. These islands, when first discovered by the Portuguese, were inhabited by Arabians; but at present they are chiefly occupied by the descendants of Portuguese. S. lat. 12° 20'.—Also, a country of Africa, bordering on the coast. S. lat. 9° to 13°.—Also, a river of Africa, which runs into the Indian sea, S. lat. 12° 20'.

QUERKEINESS, or KERKEINES, two islands in the Mediterranean, near the coast of Tripoli; one of them about ten miles long and five wide, anciently called "Cer-

cina;" the other, which is smaller, is united to the larger by a bridge; 15 miles S.S.E. of cape Oudia. N. lat. 34° 59'. E. long. 11° 12'.

QUERO, a town of South America, in the jurisdiction of Riobamba.

QUERPO. See CUERPO.

QUERQUEDULA, in *Ornithology*, a species of *Anas*. See DUCK and TEAL.

QUERRE', in *Geography*, a town of France, in the department of the Mayne and Loire; 12 miles N. of Angers.

QUERRIEN, a town of France, in the department of the Finistère; six miles N. of Quimperle.

QUERRIES, or EQUERRIES. See EQUERRY.

QUERRIEUX, in *Geography*, a town of France, in the department of the Somme; six miles N.E. of Amiens.

QUERRY, *Gentleman of the*, is an officer appointed to hold the king's stirrup, when he mounts on horseback.

QUERS, in *Geography*, a town of France, in the department of the Upper Saone; three miles S.E. of Luxeuil.

QUESADA, a town of Spain, in the province of Jaen; 12 miles S.E. of Ubeda.

QUESENDORF, a town of Prussia, in the palatinate of Culm; four miles S.E. of Bretchen.

QUESNAY, FRANCIS, in *Biography*, a celebrated French physician, was born at Mercey, a little town not very distant from Paris, in 1694. His family were employed in rustic occupations, and gave him no other education than was deemed necessary for their mode of life; so that at the age of sixteen he was scarcely able to read. About this time, however, a thirst for information seized him, and partly by the assistance of a country surgeon, and the few books that he possessed, but principally by his own labour, he acquired a knowledge of Latin and Greek, and entered with ardour into the study of the ancient and modern writings on philosophy. In opposition to the grovelling notions of his relations, he resolved to turn his pursuits to medicine, having perceived its connection with the various branches of physical science; and his master, the surgeon of Ecqueville, was soon convinced of the superior acquirements of his pupil, some of whose essays he presented as his own, on applying for admission into the college of St. Côme, and they were received with great applause. This still farther roused the zeal of Quesnay, and he repaired to Paris, where he entered with great assiduity into the studies connected with the profession. After some time he settled at Mantes, a considerable town in his native province. Here he was discovered by Garegeot, an eminent surgeon, who was engaged with Peyronie in an attempt to establish an academy of surgery, for the collection of surgical knowledge. Having written a refutation of the doctrines of Silva, respecting blood-letting, which led him to a public controversy, in which he was deemed victorious by Peyronie, he displayed such profound views, indefatigable zeal, and great general knowledge, as determined Peyronie to appoint him the secretary of his new academy. This distinguished post raised him still higher in the public estimation; but the labours connected with it at length injured his health, which had been for some time delicate, and he determined to turn his attention to medicine more particularly, and took the degree of doctor of physic. He had been employed during the campaigns of the king, and on the death of M. Terray was appointed consulting physician to his majesty; and was much esteemed and favoured by madame de Pompadour; he seems, indeed, to have been much employed, and to have been held in high consideration by the dauphin,

the father of Louis XVI., and by the whole court. After the dauphin had undergone the small-pox, the king presented him with letters of nobility, unsolicited, as a mark of his esteem. He was appointed also first physician in ordinary to his majesty. He was a member of the Academy of Sciences, of the Royal Society of London, &c. Notwithstanding his long life, and his courtly favour, as well as extensive employment, he died possessed of little fortune, his liberality to his friends having prevented him from accumulating money. His death took place at Versailles, in December, 1774, at the age of eighty.

This able and indefatigable man left several works, which bear the stamp of considerable research, clear and methodical views, and acute observation, mixed, however, with some disposition to hypothesis. His first essay on blood-letting, already mentioned, was published in 1730, under the title of "Observations sur les Effets de la Saignée, avec des Remarques critiques sur la Traité de Silva;" and a second edition, considerably enlarged, was printed in 1750. But in the mean time he published another work, entitled "L'Art de Guérir par la Saignée," Paris, 1736, in which he recommends blood-letting in many diseases. In the same year appeared his "Essai Physique sur l'Economie Animale," in two volumes, 12mo., which was reprinted in 1747, in three volumes. This work, however, was deemed very imperfect by Haller, and is in fact characterized by a love of hypothesis, rather than by the details of experience and observation. In 1743, his "Preface des Memoires de l'Academie de Chirurgie," gained him considerable applause, as a work of literary research. In 1744 he published his "Recherches critiques et historiques sur l'Origine, sur les divers Etats, et sur les Progrès de la Chirurgie en France," which called forth some replies on the alleged inaccuracy of some of the historical statements. His other publications were entitled, "Testament de M. de la Peyronie du 18 Avril, 1747;" "Examen impartial des Contestations des Medecins et des Chirurgiens de Paris," 1748, 12mo.; "Memoire présenté au Roi par son premier Chirurgien, où l'on examine la Sagesse de l'Ancienne Législation sur l'Etat de la Chirurgie en France," 4to.; "Traité de la Suppuration," 12mo.; and "Traité de la Gangrene," 12mo.; all in the year 1749. And lastly, his "Traité des Fièvres continues," 1753, in two volumes, 12mo. Eloy Dict. Hist. de la Médecine.

QUESNE, ABRAHAM DU, an able French naval commander, was descended from a noble family in Normandy. He was born in 1610, and was brought up to the sea-service under his father, who gave him the command of a vessel when he was only seventeen years of age. In 1637 he was present at the attack of the isles of Sainte Marguerite, and in the following year contributed greatly to the defeat of the Spaniards before Gattori. He was afterwards in various actions on the coast of Spain. In 1644 he went to serve in Sweden, and was promoted to the rank of vice-admiral of the Swedish fleet. In this station he had a command in the famous battle in which the Danes were entirely defeated, and his vessel was one that boarded and took the enemy's admiral ship. On his return to France he commanded a squadron sent to the expedition against Naples. The French navy being in a low state on account of the minority of the king, he fitted out several ships at his own expence in 1650, with which he assisted in the reduction of Bordeaux, which had revolted, and was aided by a Spanish fleet. In 1676 he had the glory of being opposed to the great De Ruyter. The Spanish and Dutch fleets had united to prevent the French from succouring the inhabitants of Messina, but Du Quesne, after a desperate fight, succeeded

in entering the port. He was also engaged with De Ruyter when the latter was mortally wounded. Du Quesne obtained a more glorious and decided success in another engagement with the Spanish and Dutch fleets at Palermo, when, by means of his fire-ships, he destroyed twelve large ships of the enemy, and thus procured for his king the sovereignty of the Mediterranean. In 1682 he was sent with a fleet to awe the piratical states of Barbary, which had committed depredations on the French coasts, and in the following year he sailed to Algiers, and bombarded the town with such fury as nearly to lay it in ruins. In the following spring the admiral anchored before the city, and did not leave it till he had destroyed almost all the buildings, with the whole of the shipping and fortifications, the consequence of which was they were obliged humbly to sue for peace. He struck equal terror into the states of Tripoli and Tunis, which were likewise compelled to purchase peace with France by submission. He performed other great and important services for his sovereign, but the recompence due to him on account of all he did was impeded by his firm attachment to the reformed religion in which he was bred, and which the bigotry of the king regarded as criminal. He received, however, the royal gift of a fine estate, which was erected into a marquisate, and gave him a title; and on the repeal of the edict of Nantes, he was the only person exempted from its penalties. This great hero, one of the chief boasts of the French navy, preserved an extraordinary degree of health and vigour, notwithstanding the many wounds which he had received, till his death in 1688, when he had attained to the 78th year of his age. He left a son, of whom we shall say a few words.

QUESNE, HENRY DU, was born in 1652, and at the age of fourteen he entered the French navy, and served with great distinction under his father. He was present at the bombardment of Algiers in 1683, and negotiated the peace of Tunis. At the period when the highest prospects in his profession lay before him, his attachment to the Protestant religion caused him, at the repeal of the edict of Nantes, to quit his country and the service, but he refused with indignation the offers that were made him to take a command in the armies of its enemies, and retired to Switzerland. His high reputation raised him to great credit with the Protestant powers, which he employed in engaging them to undertake the protection of his persecuted brethren; and through his means a great number of victims of the most cruel intolerance procured their liberation from the galleys. In 1701 he sold his estate in Switzerland, and retired to Geneva, of which he was admitted to the citizenship. Here he died in 1723, respected alike for his learning and piety. As an author he had taken a considerable share in the version of the New Testament published by the pastors of Geneva, and he was author of a work entitled "Reflexions Anciennes et Modernes sur l'Eucharistie."

QUESNE, *Fort du*, in *Geography*. See PITTSBURG.

QUESNEL, PASQUIER, in *Biography*, a French priest of much celebrity, was born at Paris in the year 1634. Having completed his education, and being admitted a member of the congregation of the oratory, he took priest's orders in 1659. From this time he devoted himself, with great diligence, to the study of the scriptures, and of the fathers, and to the composition of books in practical piety. At the age of 28 he was appointed first director of the institution belonging to his order at Paris. The first of his publications was entitled "Moral Reflections upon the Gospels." After this he was employed in preparing for the press a new edition of "The Works of St. Leo," in two volumes, 4to. in which he has given a vast number of notes

that reflect great honour on the learning of the editor. Its value was enhanced, in the judgment of his countrymen, by his introducing into it an able defence of the sentiments of the Gallican church, in opposition to the pretensions of the church of Rome. This circumstance gave great offence to the papal government, and the edition was condemned in the following year at Rome. On account of his attachment to father de Sainte-Marthe, general of the oratory in France, he was obliged to quit his diocese, and from other unpleasant circumstances he thought it right to withdraw privately from France into foreign countries. He took refuge at Brussels, where he continued his "Moral Reflections" on the acts of the apostles, and the epistles. This, with his former work, he published in 1687. He afterwards revised and made additions to the former work on the Evangelists, and printed an uniform edition of the whole in 1693 or 1694, in four vols. 8vo. In the year 1703 the Jesuits, always inimical to the rights and liberties of mankind, and who, to the utter disgrace of the present period, have been just re-established in their powers, availed themselves of their influence with an ignorant and bigotted king of Spain, to obtain an order for the arrest of father Quefnel, who was now thrust into a dungeon belonging to the archiepiscopal palace at Brussels. From this situation he was unexpectedly delivered in less than four months by the ingenuity of a Spaniard, who contrived to open a passage through the walls of the prison sufficiently large for his escape. Having thus obtained his liberty, he made the best of his way to Holland, where he published several pieces in vindication of himself and writings from charges preferred against both before the ecclesiastical court of Mechlin, and the sentence of condemnation pronounced by the archbishop. In the year 1705 the enemies of Quefnel applied to the pope Clement XI. for the condemnation of the "Moral Reflections," to which he acceded, although he had some years before expressed his decided approbation of them, and even wished to engage the author to come to reside at Rome. Such, however, was the pontiff's inconsistency, that he issued a decree which condemned the "Moral Reflections" in general, but without specifying any particular doctrines which merited such a sentence. At length, at the instigations of the Jesuits, eager in the cause of persecution, Lewis XIV. joined himself against Quefnel, and applied to the pope for a more definite decree; his holiness, for so the most wicked as well as most virtuous of the popes have ever been denominated, in consequence of this application, established a congregation of cardinals, prelates, and divines, to enter into a particular examination of the doctrines and maxims which Quefnel had advanced. That his work might not be condemned without any efforts on his part to vindicate it from the accusations of his enemies, our author wrote, on this occasion, two letters to the pope, which were safely conveyed to Rome, but Clement did not deign to give a reply. State policy had already determined what measures he should adopt, and, after the sessions of the congregation were ended, he issued the celebrated bull Unigenitus, in September 1713, which pronounced a sentence of condemnation upon 101 propositions extracted from the "Moral Reflections."

Father Quefnel spent the last years of his life at Amsterdam, where he formed some Janenist churches, and published his apologetic and controversial pieces against the bull Unigenitus, and its abettors. He died in 1719, in the 86th year of his age. Independently of his "Moral Reflections," he was author of several other works of high reputation, of which we may mention, a treatise on "Predestination and Grace," in four vols. 12mo. under the fictitious name of

fleur Germain; and "The Discipline of the Church deduced from the New Testament," in two vols. 4to. A list of this author's works may be seen in Moreri.

QUESNOI, FRANCIS DU, called the Fleming, an excellent sculptor, was born at Brussels in 1594. He learned his art under his father, who was a sculptor, and at an early age displayed so much ability, that the archduke Albert gave him a pension and sent him into Italy. After the death of that prince, he was patronized by the constable Colonna; and the celebrated Poussin residing with the constable at the same time, the two artists contracted an intimate friendship, and studied together. Quesnoi formed himself upon the taste of the ancients, and chiefly excelled in making bas-reliefs and models in a small size, representing cupids and children, to which he gave singular grace and delicacy. He employed himself several years on a marble saint, for the chapel of Loretto, in which he imitated the genuine beauties of the antique. When the canopy of St. Peter's was finished, pope Urban VIII. ordered four colossal statues to be placed in the niches. That of St. Andrew was given to Quesnoi, and although one of his competitors ventured to affirm that he would only produce a great child, yet when the figure was completed, it entirely effaced his own performance. Notwithstanding the talents of this artist, which were united to much perseverance and industry, he could barely earn a subsistence, and was in a very low state of health and spirits, when, in 1642, Lewis XIII. engaged him as his sculptor, and as the head of an intended school for that branch of art, at a very liberal salary. This change of fortune he was unable to bear, and as he was on the point of setting out, he sunk into a melancholy derangement, from which he never recovered. His death, which happened at Leghorn in 1646, has been imputed, but probably on insufficient evidence, to poison, administered by the hand of a brother with whom he lived on very bad terms. He was mild in his manners, but of a reserved disposition. His reputation is chiefly founded upon the exquisite softness which he gave to marble, and the peculiar grace and beauty of his infantile groups, finished with perfect anatomical exactness.

QUESNOY, LE, in *Geography*, a town of France, in the department of the North, and chief place of a canton, in the district of Avesnes. The place contains 2960, and the cantons, to which belong the east and west divisions, 9099 each, on a territory of 235 kilometres, in 29 communes. N. lat. 50° 15'. E. long. 3° 43'.

QUESNOY-*sur-Deule*, a town of France, in the department of the North, and chief place of a canton, in the district of Lille. The place contains 4002, and the canton 15,047 inhabitants, on a territory of 82½ kilometres, in nine communes.

QUEST, or INQUEST, an inquisition, or inquiry, made upon oath of an impannelled jury. See INQUEST, and JURY.

The word is formed from the French *quete*, *search*; of the Latin *quesitum*, *a thing sought*.

QUEST, in *Hunting*, the seeking out of hounds, or the venting and winding of spaniels. See HOUND.

QUESTEMBART, in *Geography*, a town of France, in the department of Morbihan; five miles W.S.W. of Rochfort. The place contains 3668, and the canton 12,118 inhabitants, on a territory of 257½ kilometres, in nine communes.

QUESTION, QUÆSTIO, in *Logic*, &c. a proposition, whose truth a person being inquisitive about, proposes by way of interrogation to another.

Logical questions are variously distributed; the ordinary division

division is into *first* or *primary* questions; as, *Quid est? What is such a thing?* And *secondary*, which arise out of the former; as, *How is it?*

QUESTION, *Quodlibetical*. See QUODLIBETICAL.

QUESTION, in *Law*. The *questio de jure* is generally to be distinguished from the *questio de facto*.

QUESTION is also sometimes used for *torture*; which see.

QUEST-MEN, persons chosen yearly in each ward, to inquire into abuses and misdemeanors, especially such as relate to weights and measures.

QUEST-MEN, in *Ecclesiastical Law*. See SIDESMEN.

QUESTOR, QUÆSTOR, formed a *querendo, seeking, searching, or collecting the revenues of the state*, an officer in ancient Rome, who had the care of the public treasure.

The questorship, *questura*, is very ancient, as having been established under the kings, probably in the time of Romulus or Numa, or at least under Tullus Hostilius. Tacitus (Annal. xi. 22.) says, that the first questors were elected by the people, 64 years after the foundation of the republic; but he is of opinion that they had, long before that period, been annually appointed by the consuls, and even by the kings. But this obscure point of antiquity is contested by other writers. Dionysius and Livy date the original of questors about A. U. C. 269. Plutarch refers the institution to the time of Valerius Poplicola, when he allotted the temple of Saturn for the treasury, and granted the people the liberty of choosing two young men for the treasurers. Afterwards, viz. A. U. C. 332, two others were created to take care of the payment of the armies abroad, of selling the plunder and booty, &c. for which purpose they generally accompanied the consuls in their expeditions; and they were distinguished by the name of *peregrini* from the other questors, who assumed the title of *urbani*. This number continued till the entire conquest of Italy; and then, A. U. C. 439, it was again doubled. The four that were added resided with the proconsuls and prætors, in the provinces, where they were employed in regulating the taxes and customs due to the state.

In the time of the republic, the senate appointed questors in each province, to assist the proconsuls, as lieutenants or treasurers, in the administration of the revenues; but, under the emperors, there was properly but one questor, or treasurer-general of the empire; those other inferior or subordinate questors were then called assistants of the questor, *adjutores questoris*.

The questor's office was originally confined to the army. They paid the soldiery, and took charge of monies coming by spoil and plunder, &c.

At length there were new ones erected to reside in the city, and to receive the public money, taxes, tribute, &c. Their number was increased as the empire increased. Sylla augmented it to twenty; Julius Cæsar to forty; some being nominated by the emperor, and the others by the people. Tacitus (Annal. xi. 22.) seems to consider twenty as the highest number of questors; and Dion (lib. xliii. p. 374.) intimates, that if the dictator Cæsar once created forty, it was only to facilitate the payment of an immense debt of gratitude. Under succeeding emperors their number was not fixed. Of these, two were appointed for the city, to take care of the public treasure, and to keep the laws and decrees of the senate; the others pertained to the provinces and the armies.

The questorship was the first office which any person could bear in the commonwealth, and might be undertook at the age of twenty-four or twenty-five years. Accordingly, the questorship was called the first step of honour,

and the questors, who were generally employed in the provinces abroad, assigned to them severally by lot, no sooner returned from their provincial administration than they took their places in the senate; and from that time forward, from the rank of equestrians, or what we commonly call knights, became senators for life.

The youth and inexperience of the questors, who entered on that important office in the 25th year, engaged Augustus to remove them from the management of the treasury; and though they were restored by Claudius, they seem to have been finally dismissed by Nero. In the provinces of the imperial division, the place of the questors was more ably supplied by the procurators, or, as they were afterwards called, "rationales." But in the provinces of the senate we may still discover a series of questors till the reign of Marcus Antoninus. From Ulpian we may learn, that under the government of the house of Severus, their provincial administration was abolished; and in the subsequent troubles, the annual, or triennial elections of questors, must have naturally ceased.

There was also another kind of questors, called *questores parvitiæ*, whose office was to enquire into, and take cognizance of capital crimes, after the consuls were denied this privilege.

QUESTOR *facri palatii*, or of the *sacred palace*, was one of the first dignities under the emperors of Constantinople.

It was this questor that subscribed the rescripts of the emperor, and the answers to the petitions and supplications presented to him. He also drew up and signed the laws and constitutions which the emperor thought fit to publish; and took care of the administration of justice.

Some compare his function to that of our lord high chancellor. It was usually one of the juriconsulti that was charged with this office; it being required, that he should know the laws of the empire, be able to prescribe and see them executed, and judge of causes brought by way of appeal before the emperor.

Constantine was the first who created questors of the sacred palace.

QUESTUS, or QUÆSTUS. See QUÆSTUS.

QUESTUS *est nobis*, a writ of nuisance, which, by stat. 15 Edw. I. lies against him to whom a house, or other thing, that breeds a nuisance, is descended, or alienated; whereas before that statute, the action lay only against him who first levied, or caused the nuisance, to the damage of his neighbour.

QUÉTIF, JAMES, in *Biography*, a learned French Dominican monk, was born at Paris in the year 1618. He embraced the monastic profession among the preaching friars when he was not more than 17 years of age, and having completed his philosophical course at Paris, he was sent by his superiors to Bordeaux, where he studied divinity, and received priest's orders in 1648. He lived to a great age, exercising his talents in various ways, and died in the year 1698, highly respected for his great erudition, his extensive knowledge, and his virtues. He published a new edition of the "Summa Theologiæ" of Aquinas, in three vols. folio, with notes. He did the same by a work entitled "Concilia Tridentini Canones." He was editor of "The Spiritual and Ascetic Letters of Savonarola;" and he published, with his own notes, "The Life of Savonarola," from the Latin of John Picus, count of Mirandula, with considerable additions. He wrote the preface to "The Letters of Peter Morin," which he published from the author's manuscripts; as he also did his treatise "On the good Use or Abuse of the Sciences." He was author of a considerable part of the work

work entitled "Scriptores Ordinis Prædicatorum, cum notis Historicis," which was completed by father Echard.

QUETREVILLE, in *Geography*, a town of France, in the department of the Channel; six miles S. of Coutances.

QUETTEHOU, a town of France, in the department of the Channel, and chief place of a canton, in the district of Valognes; nine miles N.E. of Valognes. The place contains 1291, and the canton 14,956 inhabitants, on a territory of 150 kilometres, in 18 communes.

QUETTENBRUN, a town of Austria; eight miles E. of Laab.

QUETZ, a town of Saxony, in the circle of Leipzig; two miles S.S.E. of Zorbig.

QUEVACAMPS, a town of France, in the department of Jemappe, and chief place of a canton, in the district of Tournay. The place contains 955, and the canton 10,264 inhabitants, on a territory of 107½ kilometres, in 15 communes.

QUEVAUVILLERS, a town of France, in the department of the Somme; eight miles S.W. of Amiens.

QUEUE, in *Commerce*, a wine measure used in some parts of France. A queue of Champagne contains 384 pintes of Paris, or about 95 English gallons; a queue of Burgundy contains 432 pintes of Paris, or 107 English gallons.

QUEUE, *Fr.* tail, as applied to the heads of musical notes; the minim is the only white note with a tail to it, and the crotchet the first black note with a tail to it.

QUEUE, in *Heraldry*, the tail of a beall.

If a lion has a forked tail, he is blazoned by double-queued.

QUEUE d'Aronde, *q. d. swallow's tail*, in *Fortification*, a term applied to outworks, when narrower at the gorge than at the face or front; *i. e.* where the sides open towards the champaign, and contract towards the gorge. The name is occasioned by its resemblance, in figure, to a swallow's tail, which the French call queue d'aronde.

Of this kind are some single as well as double tenailles; and some horn-works whose sides are not parallel.

On the contrary, when the sides are less than the gorge, the work is called *contre queue d'aronde*.

QUEUE d'Aronde, in *Carpentry*, a method of jointing, called also dove-tail.

QUEVEDO DE VILLEGAS, FRANCISCO, in *Biography*, a celebrated Spanish writer, was born at Madrid in 1570. He became distinguished at an early period for his literary attainments, and obtained the honour of knighthood, but indulging his satirical vein too freely against the administration of count d'Olivares, he was thrown into prison, from whence he did not make his escape till the disgrace of that minister. He died in the year 1645, at the age of 75. He is regarded by his countrymen as having attained to a considerable degree of excellence in most of the different kinds of composition. His heroical poems are said to be characterized by energy and spirit; his lyrical by sweetness and beauty; and his humorous poems by ease, pleasantry, and ingenious invention. His printed works fill three vols. 4to. of which two are occupied by poetry and one by prose. The former were collected by Joseph Gonzales de Salas, who illustrated them with notes and dissertations. They were published in 1650, at Madrid, under the title of "Il Parnasso Español." The humorous pieces of Quevedo have rendered his name best known in foreign countries, and have been translated into the English and other languages.

QUEVILLY, in *Geography*, a town of France, in

the department of the Lower Seine; three miles W. of Rouen.

QUEULEN, a river of Chili, which runs into the Pacific ocean, S. lat. 39° 10'.

QUEYPO, a town of Mexico, in the province of Costa Rica, near the Pacific ocean.

QUEYRAS, a town of France, in the department of the Higher Alps; 12 miles S.E. of Briançon.

QUEYTOR, a name sometimes given to the river Ava, at least to that part which runs between Ava and Prom.

QUI, in *Rural Economy*, a common term frequently applied to the female of the cow kind of animals while in the young state. It is the most generally employed in the northern parts of the country. See *WHY*.

QUI-Calf, a name usually made use of in the northern parts of the island, to signify a female or heifer calf. See *WHY-Calf*.

QUI Tam, in *Law*, is used where an information is exhibited against any person on a penal statute at the suit of the king and the party who is informer, when one part of the penalty for breach of the statute is to be given to the king, the poor, or to some public use, and the other part to the informer or prosecutor; and the party informing prosecutes for the king and himself. The suit is called a *qui tam* action, because it is brought by a person, "*qui tam pro domino rege, &c. quam pro se ipso in hac parte sequitur.*" If the king, therefore, himself commences this suit, he shall have the whole forfeiture. (2 Hawk. P. C. 268.) But if any one hath begun a "*qui tam*" or "*popular*" action, no other person can pursue it; and the verdict passed upon the defendant in the first suit is a bar to all others, and conclusive even to the king himself. This has frequently occasioned offenders to procure their own friends to begin a suit, in order to forestall and prevent other actions; which practice is in some measure prevented by a statute made in the reign of a prince very sharp-sighted with regard to penal laws, *viz.* 4 Hen. VII. c. 20.; which enacts, that no recovery, otherwise than by verdict, obtained by collusion in an action popular, shall be a bar to any other action prosecuted *bonâ fide*. A provision, says judge Blackstone, that seems borrowed from the rule of the Roman law, that if a person was acquitted of any accusation, merely by the prevarication of the accuser, a new prosecution might be commenced against him. Ff. 47. 15. 3. See *INFORMATION*.

QUIA, in *Logic*. See *REASON*.

QUIA dominus remisit curiam, in *Law*. See *RECTO*.

QUIA emptores, a denomination given to the statute of Westm. 3. 18 Edw. I. which directs, that upon all sales or feoffments of land, the feoffee shall hold the same, not of his immediate feoffor, but of the chief lord of the fee, of whom such feoffor himself held it; and hence it is held that all manors existing at this day must have existed by immemorial prescription, or at least ever since this statute was made: for no new manor can have been created since that statute; because it is essential to a manor, that there be tenants who hold of the lord, and that statute enacts, that for the future no subject shall create any new tenants to hold of himself.

QUI improvidé, a superfluous grant in many cases where a writ is erroneously sued out, or misawarded.

Such is that granted in behalf of a clerk of the chancery sued against the privilege of the court, in the common pleas, and pursued to the extent.

QUIADKOUA, in *Geography*, a town of Prussia, in the province of Bartenland; nine miles S.E. of Allersburg.

QUIBBLETOWN, a town, or rather a village of America,

rica, in Middlesex county, New Jersey; six miles N. of New Brunswick.

QUIBERON, a fortified town of France, in the department of Morbihan, and chief place of a canton, in the district of L'Orient, situated at the extremity of a peninsula, to which it gives name, opposite to the island of Belle Ile; remarkable for an unfortunate expedition of English troops and emigrants against France, in the year 1795; 17 miles S.E. of Port Louis. The place contains 1916, and the canton 5618 inhabitants, on a territory of 95 kilometres, in three communes. N. lat. $47^{\circ} 30'$. W. long. $3^{\circ} 2'$.

QUIBO, a small island on the outer part of the bay of Panama; it is uninhabited, but affords wood and water for shipping.

QUIBONDO, a small island in the Indian sea, near the coast of Africa. S. lat. $8^{\circ} 8'$.

QUIBOR, a town of South America, in the government of Caracas; 15 miles S.W. of Segovia Nuova.

QUIBURI, a town of New Navarre; 20 miles S.S.E. of Casa Grande.

QUICAPOUX, a river of America, which runs into the Mississippi, N. lat. $43^{\circ} 4'$. W. long. $92^{\circ} 5'$.

QUICARO, a town of New Navarre; 150 miles S.S.E. of Casa Grande.—Also, a small island in the Pacific ocean, near the coast of Veragua. N. lat. $7^{\circ} 54'$. W. long. $82^{\circ} 42'$.

QUICI, in *Entomology*, a species of the cerambyx, mentioned by Marcgrave.

QUICK, in *Gardening*, a term applied to signify any sort of young plant, but especially those of the white-thorn kind. By it is also often understood a live hedge, but more properly the shrubs of which such live hedge is formed. In a strict sense it is, however, applied to the *cratægus oxyacantha*, or hawthorn, the young plants or sets of which are commonly sold by the nursery gardeners under the name of quicks.

In the choice of these sets, those which are raised in the nursery are in general to be preferred to such as are drawn out of the woods, as the latter have seldom good roots: many persons, however, prefer them, as they are larger plants than are commonly to be had in the nursery. See *CRATÆGUS*.

QUICK. See *MEDLAR* and *PYRUS*.

QUICK-Beam. See *PYRUS*, and *SERVICE-Tree*.

QUICK-Beam, in *Planting*, a name given in some places to the tree usually known by the title of mountain-ash. It has been recommended as useful for forming fences, in some cases, by Dr. Anderson, and others. Where it is employed in this way, the plants must be kept down to the proper height, by being cut over as often as there may be occasion; and thus encouraging them to throw out lateral branches in a greater abundance, and, of course, induce the fence to become more close and thick in its lower parts. By these means a tolerably perfect hedge may be raised, from plants of this sort, in situations where the white-thorn will not succeed in any proper manner.

QUICK-Hatch, in *Zoology*. See *URSUS Lufcus*.

QUICK-Hedges, in *Agriculture*, a name given to all such as are raised from quicks, or any other sort of living plants. The proper forming and planting of quick-hedges have hitherto been much too little attended to by the farmer, as it is a matter of great importance, and which interests him in a very high degree. Whatever sort of plants may be employed for this purpose, the work should constantly be well performed in the first instance, and the hedges and plants be afterwards kept in due order and regularity by suitable pruning,

cutting in, and other proper management. There is a great number of different methods of raising and making hedges of this kind, as by planting the sets on the plain surface, or the mould a little raised above it, or on mounds, formed by the fods and mould dug up in the line of the hedge, elevated to different considerable heights; by setting the plants out in one row only, in double ones, or sometimes in a still greater number; by putting them in, in straight lines, in irregular manners, in the triangular form, or in the quincunx method. They are sometimes cut over at certain heights, at others not cut down at all; the sides are also in some cases clipped or cut in, but in others this is avoided altogether. When planted on banks, they are mostly cleaned and moulded up annually.

A great variety of different sorts of plants is employed in forming and constructing these hedges, as those of the hawthorn, the black-thorn, the crab-tree, the hazel, the willow, the beech, the elder, the poplar, the alder, and several other kinds, according to particular circumstances and situations. And on the exposed coasts or shores of the southern parts of the kingdom, a new sort of shrub or plant has lately been recommended for this use, which is that of the tamarisk, or *tamarix gallica*, as it thrives rapidly, it is said, when planted in situations most exposed to the blast or stroke of the sea; forms an admirable shelter, and being of quick growth, soon comes to answer the end designed. The writer of the agricultural report of the county of Cornwall has known a hedge of it, which he has been told was planted about seven years ago, and the bushes, apparently, cannot be less now than from ten to twelve feet in height, and are feathered to the very bottom. It thrives well about the Lizard, bears cutting perfectly well, and in exposed situations, where it might be injured if left to grow high, may be kept close and low to much advantage. It unfortunately, however, will not stand the frost, and should never be attempted, of course, in situations exposed to the severe effects of it. The propagation of it is by cuttings, which take root without any difficulty. It is supposed that this shrub was brought by the monks from Normandy to Mont St. Michael in the above county, and thence spread to other parts. See *HEDGE*, and *QUICKSET Hedge*.

The quick-hedges of this country are in a very great degree raised from the white-thorn, which unquestionably forms the cheapest and most durable kind, where the nature of the soil, situation, and other circumstances are favourable for the purpose. It will not, however, flourish in bad land, in exposed situations, where the bottom is wet and springy, or where the growth of weeds is very abundant. In all such cases other kinds of plants are therefore had recourse to in the formation of them.

In many upland districts beech-hedges have been planted to considerable extents, and found, when kept under proper management, to be very handsome, and of great service in such exposures. Birch-hedges have likewise been tried in different cases, and found to grow remarkably fast, even in cold bare stony soils, but they require to be cut over at the time they are about four feet in height and carefully plashed. Both these sorts of hedges have this in their favour, that they will grow in very poor soil as well as in very exposed situations; and both will flourish and grow strongly where the white thorn cannot live. Their want of prickles, however, is a great objection to them in this view: but they afford good shelter.

Quick-hedges constitute the ordinary sort of fences in this country, and unless in particular situations, and for particular purposes, are the most proper and eligible. It has

been

been observed by the writer of a late work, that in parts which have been long inclosed without arable cultivation, hedges, of seemingly great age, are met with, which are many times crooked, ragged, and irregular, as though they had been, in the first instance, formed and laid out from the wild underwood of such places. While in other cases, low plants of the various coppice kinds rise and grow on dikes or mounds but little raised above the surface of the land, seemingly as though they had formerly been collected from brush-woods and replanted on such banks, in somewhat the same manner as is still practised on higher banks in particular districts towards the west, and in South Wales. But taking the country at large, the method of raising quick-hedges by setting grown plants taken from such situations, has long ceased to exist and prevail as a general practice; young plants of white-thorn, or other sorts, set out in the bank and ditch mode with a low protecting dead fence on the side contrary to the ditch at first, is the plan commonly had recourse to, such plants being first raised in small grounds for the purpose in regular rows, and not taken, as formerly, from brush-woods and waste commons.

Quick-Lime, in *Rural Economy*, such lime as is in the caustic or most active state, and which possesses the greatest power of operating upon different substances with which it may come in contact. It is quite the opposite in its qualities and properties, to that which has fallen down into a powdery state, in consequence of being saturated with water and carbonic acid gas, or fixed air, or which is flaked and become effete. Its powers, when applied upon land in this condition, have already been noticed in speaking of lime. See *LIME*.

But it possesses qualities and properties in the way of a cement, the utility of which for building, for various domestic purposes, properly belong to this place. According to Dr. Anderson, lime is in the best and most fit state for this use when the most perfectly caustic, or in the most crystallizing condition. It is remarked, that the powder of lime, when reduced by means of water into a thin or fluid sort of paste-like form, and then suffered to become dry, concretes into a coherent mass, which fixes to stones and other rough bodies in a very firm manner, and in this way becomes a proper cement for building any sort of walls. And that, after this pasty material has once become firmly dry, it is quite indissoluble in water, and incapable of ever being softened again by the moisture of the atmosphere or other similar causes. Hence it excels many other sorts of cements.

When composed for the purpose of building walls, &c. it is usually denominated *mortar*; but when formed as an application in the way of a smooth coating upon any plain surface without intermixture with stony matters, it is commonly here termed *plaster*.

When made from the lime of the purer sort of lime-stone, it is found to be more soft and crumbly, and to acquire a less degree of hardness, and to be broken with much less force, than where the lime-stone from which it is made contains a large proportion of sand, in which case it becomes much more hard, firm, and durable.

It has, however, been discovered that the purest lime may be rendered a firm cement by adding a proper proportion of clean hard sand to it; hence the practice of blending sand with lime, when intended for mortar, has become so universal. This is fully shewn to have been very early the case, by the oldest lime-built walls which are now to be met with.

It nevertheless still remains a desideratum to ascertain the due proportion of sand which is necessary, as both writers

and practical masons greatly disagree in opinion on this matter, as well in their directions about the mode of mixing the materials, as of applying the cement; some of the more modern, especially, ascribing extraordinary effects to a small variation in these particulars, while others deny that the circumstances have any sensible effect on the durability and firmness of the cement.

It is conceived that these different and contradictory opinions arise from an imperfect knowledge of the nature of quick-lime, and the variations it may admit of; for these variations are so very great, as to render it impossible to afford any general rules that can possibly apply in all cases. It is, therefore, conceived to behove those who are desirous of acquiring any consistent and satisfactory knowledge on this head, to endeavour to ascertain, in the first place, the circumstances which render calcareous substances *at all* capable of becoming a cement, and then to trace the several changes that may be produced upon it by other extraneous causes.

Having explained the circumstances which cause the differences in lime-stone, and pointed out the different constituent principles of it, as well as various other peculiarities; it is stated that lime, which has in any way absorbed its full quantity of air from the atmosphere and become mild, is altogether unfit for becoming a cement, and that, of course, it is evident, that a great change may be produced upon the quality of any lime, by having allowed less or more of it to be in this state before it is worked up into mortar. And further, that if a large quantity of water be put to fresh flaked quick-lime, and beat up with it into a thin sort of paste, the water dissolves a small portion of the lime, which as it gradually absorbs its air, is converted into crystals; between the particles of which crystals, that part of the lime which was not dissolved, and the other extraneous matters which may have been mixed with it, are entangled, so as to form a firm coherent mass of the whole. And that the pasty substance formed in this manner, is the well-known article mortar; and this heterogeneous, imperfectly semi-crystallized mass, constitutes the common cement employed in building ordinary walls or other erections. These circumstances, therefore, being known, it is thought that it will not be difficult to comprehend what are the particulars that are necessary to form the most perfect cement of this nature. That since lime becomes a cement only in consequence of a certain degree of crystallization taking place in the whole mass, it is sufficiently obvious that the firmness and perfection of that cement must depend upon the perfection of the crystals; and the hardness of the matters that are entangled among them; for if the crystals are ever so perfect and hard of themselves, if they be separated from one another by any brittle incoherent medium, it is evident that the whole mass must remain in some degree brittle and incoherent. That as water can only dissolve a very small proportion of lime, even when in its most perfect saline or caustic state, or while it remains deprived of its carbonic acid gas, and as happens in other similar cases, no more of the lime can be reduced to a crystalline mass than has been actually dissolved in the water; it happens of course, that if mortar be made of pure lime and water alone, a very small proportion only can be dissolved by that small quantity of water that is added to it: and as this small proportion alone can afterwards be crystallized, all the remaining undissolved particles of the lime will be entangled among the few crystals that are formed. And as the undissolved lime in this mass will in time absorb its air, and be converted into *mild* calcareous earth without having had a sufficiency of water to allow it to crystallize, it must concrete into a friable mass exactly resembling chalk; it follows, that this kind of mortar,

tar, when as dry as it can be made, and in its highest degree of perfection, will always be soft, and easily crumbled into powder.

But that, if, instead of forming the mortar of pure lime alone, a large proportion of sand be added to it, the water will in this case dissolve as much of the lime as in the former; and the particles of hard sand, like sticks or threads, when making sugar-candy or other crystals, while surrounded by the watery solution, will help to forward the crystallization, and render it more perfect than it otherwise would have been, so as firmly to cement the particles of sand to one another. And as the granules of sand are perfectly hard of themselves, so as not to admit of being broken down like the particles of chalk, it necessarily follows, that the cement made of these materials must be much more perfect in every respect than the former.

After considering a variety of circumstances in regard to the solubility of lime in water, and its crystallization, it is remarked, that when a large quantity of sand is mixed in the mortar, that sand will of course bear a great proportion to the whole mass; so that the water that may be mixed with the mortar will be much greater in proportion to the quantity of lime contained in this mortar, than if the whole had consisted of pure calcareous matter. And that, as the sand absorbs none of that water,—that water, now pure, is at liberty to act once more upon those few particles of caustic lime that may still remain in the mortar, which will be dissolved and converted into crystals in their turn. In this way it may happen, in some circumstances, that a very large proportion of the lime may become crystallized; so that the mortar will consist almost entirely of sand enveloped in crystalline matter, and become in due time as hard as stone itself; whereas mortar, consisting of pure lime, without sand, can hardly ever be much harder than chalk. It is not, however, to be supposed, that in any case this dried mortar will assume that transparent crystalline form, or the compact firmness of some sorts of calcareous matters, such as marble and lime-stone. In mortar, in spite of the utmost care that can ever be taken, a very considerable quantity of the lime must remain undissolved; which undissolved lime, although it may be so much separated by the sand and crystalline lime-stone as not much to affect the hardness of the mortar, yet it must still retain its white chalk-like appearance. As marble and lime-stone are, however, always formed by those particles of lime that have been wholly dissolved in water, and from which they have been gradually separated by a more slow and more perfect mode of crystallization, they have nothing of that opaque calx-like appearance, but assume other colours, and appear more firm, uniform, and compact; the sand and other matters that may be enveloped in them being entirely surrounded with a pure crystalline matter.

But to obtain the most perfect kind of mortar, it is not, however, enough that a large proportion of sand should be employed, and that the sand should be intimately mixed with the lime; it is also of the utmost importance that a large proportion of water be added; for without this it is impossible that a large proportion of the lime can be crystallized: and the mortar, in that case, would consist only of a mixture of chalky matter and sand, which could hardly be made to unite at all, and would be little more coherent than sand by itself, and less so than pure chalk. In that case, pure lime alone must afford rather a firmer cement than lime with sand. It is also of very great importance that the water be retained as long in the mortar as possible: for if it be suddenly evaporated, it will not only be prevented from acting a second time upon the lime, after

a part of what was first dissolved has been crystallized, but even the few crystals that would be formed when the water was suddenly evaporating, would be of themselves much more imperfect than they otherwise most certainly would have been. In proof of which, instances of the crystallization of common salt, lump sugar, and sugar-candy, are adduced; after which it is noticed, that every one knows what a difference there is between the firmness of the different substances; and that as great must be the difference between the firmness of that cement which has been slowly dried, and that which has been hastily hardened by the powerful action of a warm air.

It is contended, that it is owing to this circumstance that the lime, which remains all winter in a mortar tub filled with water, is always found to be much firmer and more coherent than the mortar that was taken from the same tub and used in any work of masonry, although in this case the materials were exactly the same. From the same cause, any work cemented with lime under water, if it has been allowed to remain undisturbed and uninjured until it has once become hard, is always much firmer than that which is above the surface of the water.

In order to render the force of the above reasoning more strong and convincing, lime cement or mortar is compared to a mass of matter consisting of a congeries of stones closely compacted together, and united by a strong cementing matter that had, while in a fluid state, pervaded all the interstices between the stones, and afterwards become a solid indissoluble substance. If the cementing matter be exceedingly hard and coherent, and if the stones bedded among it be also very hard and firm, the whole mass will become like a solid rock, without fissures, that can hardly be broken to pieces by the power of man. But, although the cement should be equally firm, if the stone, of which it consists, be of a soft and friable nature, suppose chalk or sand-stone, the whole mass will never be capable of attaining such a degree of firmness as in the former case; for when any force is applied to break it in pieces, although the cement should keep its hold, the solid matter cemented by it would give way, and the whole would be easily broken to pieces. Whereas in mortar, the sand that is added to it represents the stones of a solid matter in the composition, the particles of which are united together by the lime which had been formerly dissolved, and now crystallized, which becomes an exceedingly solid and indissoluble concretion. And as the particles of sand are of themselves exceedingly hard, and the cement by which they are united equally so, it is plain that the whole concretion must be extremely firm, so as to require very great force to disunite any particle of it from the whole mass. But if, instead of employing sand, the only solid body that is entangled among the cementing matter should be chalk, (as in all cases where the mortar consists of pure lime alone,) or any other slightly cohering substance, let the cementing particles of that composition be ever so perfect, it is impossible that the whole can ever attain a great degree of firmness, as these chalky matters will be easily broken asunder.

It is remarked, in addition, that a variety of conjectures have been made about the nature of the lime cement employed by the ancients. It has been thought that they possessed an art of making mortar, which has been long since entirely lost; as the cement in the walls which have been built by them, appears to be, in many cases, much firmer than that which had been made in modern times. Yet, when the mortar of these old buildings is analysed, it is found to consist of the same materials, and nearly in the same proportions, in which they are now made use of.

And

And it is thought probable, that their only secret consisted in mixing the materials more perfectly than the rapidity or avarice of modern builders will permit, in employing their mortar in a much more fluid state than is done now, and in allowing it to dry more slowly, which the immoderate thickness of many of their walls would naturally produce, without any preconcerted design on their part. Tradition has even handed down to the present times the memory of the most essential of these particulars; as the lower class of people, in every part of the nation, at this moment invariably suppose and believe that these old walls were composed of a mortar so very thin, as to admit of its being poured, like a fluid, between the stones, after they were laid in the wall: and the appearance of these old walls, when taken down, seems to favour this popular tradition. Nor is it doubted but that this may have been the case. The stones in the outer part of the wall, it is thought, were probably bedded in mortar nearly as is practised at present; and the heart, after being packed well with irregular stones, might have the interstices between them entirely filled up with fluid mortar, which would insinuate itself into every cranny, and in time adhere as firmly as the stones themselves, or even more so, if the stones were of a sandy friable nature. And that, as these walls were usually of very great thickness, it might often happen, that the water in this mortar, by acting successively upon different particles of caustic lime, would at length be entirely absorbed by successive crystallizations, so as to become perfectly dry, without any evaporation at all; in which case, a very large proportion of the original lime must have been regularly crystallized in a slow and tolerably perfect manner, so as to attain a firmness little inferior to lime stone or marble itself.

It is supposed that, upon these principles it is easy to account for the superior hardness of some old cements, when compared with that of modern times, in which a practice very different is usually followed, without having recourse to any wonderful *arcana* whatever.

Monsieur Lorient, a late French writer, imagined that he had made a perfect discovery of the way in which the ancients employed their quick-lime, so as to obtain such an extraordinary firm cement; from which discovery, he conceived, very important benefits might be derived to society. According to his opinion, the ancient cement consisted of lime and sand nearly in the same proportions as are commonly employed for that purpose at present. But instead of making it of slaked lime entirely, as is done now, he contends that they employed a certain proportion of their lime *unslaked*, which they mixed with their mortar immediately before it was used. And it is further noticed, that this newly discovered cement dries and hardens almost under the hand of the operator, without cracks or flaws of any sort; that it neither expands nor contracts with the air;—that it is impervious to moisture, and may not only be employed for making roofs of houses that are subjected to the continual dropping of water, basins, aqueducts, canals, &c. which will instantly contain water in any quantities, but even finer works of the pottery kind; that it perfectly resists frosts, and has a variety of other interesting qualities. The trials of Dr. Anderson with the same sort of materials do not, however, confirm the great certainty and utility of this discovery. “That such effects as the writer describes,” says the doctor, “will invariably be produced, merely by adding a certain proportion of unslaked lime in powder to mortar, or even by making the mortar entirely with powdered quick-lime, I may without hesitation venture to deny, not only from the reasoning that has been given, but from

actual experiment, again and again repeated by myself; and which is likewise, in some measure, corroborated by the experience of Mr. Dossie.”

On these accounts, it is supposed, that if Monsieur Lorient, has really experienced these uncommon effects from the mortar he has tried, it must have been occasioned by some other unobserved peculiarity, and not merely by the circumstance to which he seems to ascribe it. Possibly the doctor supposes the lime he employed may have been impregnated with a gypsum, or the sulphate of lime, as is probable, for many reasons. The effects and qualities of which, as to becoming a fine powder, and of suddenly setting, are well known, but it never acquires the stony hardness that lime cement is sometimes endowed with, although it takes the smoothest polish of any cement we know: on which account, it has long been employed as a plaster where fine ornaments are required.

There are unquestionably, however, many doubtful and mysterious circumstances connected with this matter, which require the aid of further trials and experience in their full explanation.

There are still further a few other circumstances that may influence the quality of common lime-mortar. If lime-stone be sufficiently calcined, it is deprived of all its moisture, and of all its carbonic acid gas, or fixed air. But experience shews, that lime-stone will fall to powder on the effusion of water upon it, when it is much less perfectly calcined, and while it still retains almost the whole of its fixed air. And that as masons have hardly any other rule for judging whether lime-stone be sufficiently calcined, except this single circumstance of its falling to a powder when water is poured upon it, it may thus easily be perceived, that the same lime may be more or less fitted for making good mortar, according to a circumstance that, in a great measure, eludes the observation of operative masons: for if it should happen that all the pieces of lime drawn from a kiln at one time, were just sufficiently calcined to make it fall to a powder with water and no more, that powder would be altogether unfit for making mortar of any kind. This is a case that can seldom happen: but as there are a great many intermediate degrees between that state and perfect calcination, it must often happen that the stone will approach nearer to one of these extremes at one time than at another; so that the mortar may be much more perfect at one time than at another, owing to a variation in this particular.

All those who have written on the subject of lime as a cement, have endeavoured to ascertain what is the due proportion of sand for making the most perfect cement. But a little attention to the matter will shew, that all rules, which could be prescribed as to this particular, must be so vague and uncertain, as to be of little utility to the practical mason; as, besides the variation which may arise from a more or less perfect degree of calcination as above, it is a certain fact, that some kinds of lime-stones are much more pure, and contain a much smaller proportion of sand than others do; some being found almost perfectly pure, while others contain eleven-twelfths of sand and all the intermediate proportions of it. Therefore it would be absurd to say that pure lime would require as small a proportion of sand when made into mortar, as that which originally contained in itself a much larger proportion of sand than any writer has ever ventured to propose for being put into mortar.

Besides, there are differences caused by the different nature of the calcination in the different sorts of lime-stone, from which it may, upon the whole, be concluded, that

QUICK-LIME.

about one-tenth of pure lime-stone is not enough calcined to admit of being made into mortar; and that of the most impure sorts of lime-stone, not above one-fourth part of the lime contained in it is so much calcined as to be in a caustic state.

The variation that is produced by these means in regard to the proportion of sand that will be required to the lime in the one or the other case, is found to be so extremely great as hardly to be conceived. It is, however, stated, that the best mortar that has been seen made, was formed of lime which had been found to contain eleven parts of sand to one of lime: to this there was added between twice and thrice its whole bulk of sand by measure; which may be allowed to have been at least three times its quantity by weight. Therefore, supposing that every particle of that lime had been so perfectly calcined as to be in a caustic state, there could not be less than forty-seven parts of sand to one of lime. As much may, however, be allowed for the uncaustic part of the lime as is pleased, and the calculation made accordingly. But it is hardly possible to suppose that above one-hundredth part of this mass, independent of the water, consisted of pure caustic calcareous earth.

On these considerations it is conceived, that it is impossible to prescribe any determinate proportion of sand to lime, as that must vary according to the nature of the lime and other incidental circumstances, which would form an infinity of exceptions to any general rule. But it would seem that it might be safely inferred that the moderns in general rather err in giving too little sand, than in giving too much. It deserves, however, to be noticed, that the sand, when naturally in the lime-stone, is more intimately blended with the lime than can possibly be ever effected by any mechanical operation; so that it would be in vain to hope to make good mortar artificially from pure lime, with such a small proportion of caustic calcareous matter as may sometimes be effected when the lime naturally contains a very large proportion of sand. But there seems to be no doubt, that if a much larger proportion of sand were employed, and if that were more carefully blended and expeditiously worked than is common, the mortar would be much more perfect than is usual in modern times, as has been proved by actual trials.

Another circumstance that tends greatly to vary the quality of cement, and to make a greater or smaller proportion of sand necessary, is the mode of preparing lime before it is beaten up into mortar. When for plaster, it is of great importance to have every particle of the lime-stone flaked before it is worked up; for, as smoothness of the surface is the most material point, if any particles of lime should be beaten up in it, and employed in work before sufficiently fallen, the water, still continuing to act on them after it was worked up, would infallibly flake such particles, which forcibly expanding themselves, would produce those excrescences on the surface of the plaster commonly termed blisters. Consequently, in order to obtain a perfect kind of plaster that will remain smooth on the surface and free of blisters, there is an absolute necessity to allow the lime to lie for a considerable time macerating or *souring* in water, before it is worked up. And the same sort of process is necessary for the lime when intended for use as mortar, though not so absolutely. Great care is, however, required in the management in this respect; the principal things being the getting of well-burnt lime, and the allowing it to macerate or *sour* with the water for only a very short time before it is used; but that which is the best burnt will require the maceration of some days in the water before it is sufficiently flaked in the whole

mass for this purpose. See *Souring Lime for Mortar and Plaster*.

It has been almost universally admitted, that the hardest lime-stone affords a lime that will consolidate into the firmest cement; and hence generally concluded, that lime made of chalk, produces a much weaker cement than what is made of marble or lime-stone. It would seem, however, that if ever this be the case, it is only incidentally, and not necessarily so. As from the nature of calcareous matter, every kind of lime is equally fit for becoming a firm cement, if it be first reduced to a proper degree of causticity, and has afterwards a due proportion of sand properly mixed with it, before it be employed in work. Different sorts of lime, without doubt, differ much from each other in the proportion of sand they naturally contain, and, of course, require very different proportions of sand to be added to them before they can be made equally perfect as a cement; which is an economical consideration, of no small moment in some cases, as it may make one sort of lime a great deal cheaper than another on some occasions, and, of course, deserves the attention of builders in general. See *LIME*.

The excellencies and defects of other substances that may be occasionally mixed with lime in making cement may be just noticed. Those commonly used as an addition to mortar, besides sand of various denominations, are powdered sand-stone, brick-dust, and sea-shells. And for forming plaster, where closeness rather than hardness is required, they are lime that has been flaked and kept long in a dry place, till it has become nearly effete, powdered chalk or whiting, and gypsum in various proportions; besides hair and other materials of that nature. But some others have been more lately advised, such as earthy balls, slightly burnt and pounded, powdered and sifted old mortar rubbish, and others of a similar kind. All of which substances are found objectionable in some respect or other for this use, sand being the only perfectly suitable material that can be easily met with; on which account it has been always justly preferred. Pure firm crystallized sand is the best, but all pure sands are not equally proper in this intention. See these substances respectively. See also *CEMENT* and *SAND*.

It is stated by sir Humphry Davy, in his work on "Agricultural Chemistry," that there are two modes in which lime acts as a cement; in its combination with water, and in its combination with carbonic acid. When quick-lime is rapidly made into a paste with water, it soon loses its softness, and the water and the lime form together a solid coherent mass, which consists of seventeen parts of water, to fifty-five parts of lime. When this hydrate of lime, while it is consolidating, is mixed with red oxyd of iron, alumina, or silica, the mixture becomes harder and more coherent than when lime alone is used; and it appears that this is owing to a certain degree of chemical attraction between hydrate of lime and these bodies; and they render it less liable to decompose by the action of the carbonic acid in the air, and less soluble in water. It is thought that the basis of all cements that are used for works which are to be covered with water must be formed from hydrate of lime; and that the lime made from impure lime-stones answers this purpose very well. Puzzolana, it is said, is composed principally of silica, alumina, and oxyd of iron; and it is used mixed with lime, to form cements intended to be employed under water. It is stated that Mr. Smeaton, in the construction of the Eddystone lighthouse, used a cement composed of equal parts, by weight, of flaked lime and puzzolana. Puzzolana, it is said, is a decomposed lava. Tarras, which was formerly imported in considerable quantities from Holland, is found

to be a mere decomposed basalt : two parts of slaked lime and one part of tarras form the principal part of the mortar used in the great dykes of Holland. It is supposed that substances which will answer all the ends of puzzolana and tarras, are abundant in the British islands. An excellent red tarras may be procured in any quantities from the Giant's Causeway, in the north of Ireland : and decomposing basalt is abundant in many parts of Scotland, and in the northern districts of England in which coal is found.

It is observed that Parker's cement, and cements of the same kind made at the alum-works of lords Dundas and Mulgrave, are mixtures of calcined, ferruginous, siliceous and aluminous matter, with hydrate of lime.

It is noticed, that the cements which act by combining with carbonic acid, or the common mortars, are made by mixing together slaked lime and sand. These mortars at first solidify as hydrates, and are slowly converted into carbonate of lime by the action of the carbonic acid of the air. It was found by Mr. Tennant, that a mortar of this kind, in three years and a quarter, had regained sixty-three *per cent.* of the quantity of carbonic acid gas, which constitutes the definite proportion in carbonate of lime. The hardness of the mortar in very old buildings is also thought to depend upon the perfect conversion of all its parts into carbonate of lime. The purest lime-stones are the best adapted, it is said, for making this kind of mortar. The magnesian lime-stones make excellent water cements, but act with too little energy upon carbonic acid gas to make good common mortar. The Romans, on Pliny's authority, made their best mortar a year before it was used ; so that it was partially combined with carbonic acid gas before it was employed, it is supposed.

It is likewise suggested, in regard to the cultivation and improvement of land by means of this material, that quick-lime in its pure state, whether in powder, or dissolved in water, is injurious to plants ; grass in several instances having been killed by watering it with lime-water : but that lime, in its state of combination with carbonic acid, is an useful ingredient in soils. Calcareous earth is found in the ashes of the greater number of plants ; and exposed to the air, lime cannot long continue caustic, but soon becomes united to carbonic acid. That lime, when combined with about one-third of its weight of water, constitutes hydrate of lime ; and that it becomes carbonate of lime by long exposure to the atmosphere, the place of the water being supplied by carbonic acid gas. On mixing freshly burnt or slaked lime with any moist fibrous vegetable matter, a strong action occurs between them, and they form a sort of compost, part of which is commonly soluble in water. In this way, lime renders matter, before comparatively inert, nourishing ; and from charcoal and oxygen, abounding in vegetable matter, it becomes converted into carbonate of lime at the same time. Mild lime, or powdered calcareous substances, have no action in this way on vegetable matter ; by their operation they prevent the too quick decomposition of bodies previously dissolved ; but do not tend to form soluble matters. Consequently it is clear that the operation of quick-lime and mild calcareous substances, depend upon wholly different principles. The former, on being applied to land, tends to bring the hard vegetable matter contained in it into more rapid decomposition and solution, as a proper food for plants. The latter only improve the texture of it, or its relation to absorption : it is merely an earthy ingredient. Quick-lime, in becoming mild, has a similar action, but while taking on that state, prepares soluble out of insoluble matter. On this depends the operation of lime in the preparation for wheat crops, its efficacy in fertilizing peats, and in bringing

into cultivation all sorts abounding in hard roots, dry fibres, or inert vegetable matter. The question, of course, whether quick-lime should be applied to land or not, depends on the quantity of inert vegetable matter it contains ; and that whether mild lime, marle, or powdered lime-stone, should be used or not, on the quantity of calcareous matter already in the land. All sorts of land are improved by mild lime, and ultimately by quick-lime, which do not effervesce with acids ; and the sandy sorts more than the clayey kinds. In land deficient in calcareous matter, but containing much *soluble* vegetable manure, the use of quick-lime should constantly be avoided, as tending either to decompose the soluble matters, by uniting to their carbon and oxygen in becoming mild, or to combine with the soluble matters, and form compounds with less attraction for water than the pure vegetable substance. The same is the case in regard to most animal manures ; but its operation is different in different cases, according to the nature of the animal matter. On the whole, it should however never be employed with animal manures, except when too rich, or for preventing noxious effluvia. It is hurtful in mixture with common dung, and tends to produce insolubility in the extractive matter. It is useful in mixture with simple vegetable barks, &c.

The solution of the question about the inutility and disadvantage of magnesian lime, which has lately been found useful in small quantities on the poorer lands in Leicestershire, as from twenty-five to thirty bushels the acre, and in larger ones, on the rich soils ; it is supposed to depend upon that sort of lime having a less attraction for carbonic acid than the other, in consequence of the portion of that substance in it, and thereby remaining longer in the caustic state ; and its becoming sooner a carbonate of lime in the rich than in the poor soils. Magnesia, while in the caustic state, is poisonous to certain kinds of plants, and acts so in the mixture as lime. It may be usefully applied in large quantities to peat-earths ; and to lands injured by too much of this sort of lime, peat-earth will be a proper and effectual remedy, when used in a suitable proportion.

More full information may be met with on this curious and interesting subject in the first volume of Anderson's *Essays on Agriculture and Rural Affairs*, in Dossie's *Memoirs of Agriculture*, vol. ii. and in sir Humphry Davy's "*Agricultural Chemistry*."

Quick-Manure, a term sometimes applied to that sort which is strewed over crops upon the surface of the land, such as foot, small dungs, different sorts of ashes, &c. As manures in this intention on pasture lands, wheat, clover, tare, and other similar crops, twenty bushels of foot is recommended to the acre, sixty bushels of rabbit or poultry dung, and fifty of pigeons' dung and ashes ; but much larger as well as smaller proportions are made use of in different instances and circumstances. The foot and dungs should be sown over the crops about the middle of March, the ashes in February, and all in the most equal and exact manner possible, as much depends upon this being properly performed. See *ASHES, DUNG, and SOOT*.

In different counties there is much difference in the use of substances of these kinds in this way as manures. In Hertfordshire the usual quantities of foot employed in this manner are from about twenty to forty bushels, on the wheat crops ; but in some places they are used to the extent of fifty or more on the acre. The application of this material is universal throughout almost every parish in the whole county, in this mode and intention. Ashes in the same district are considered by some as rendering the soil more light and open, without contributing, in any great degree,

to the nutrition of the crops over which they are sown. The proportions in which they are used to the acre over the clover, and occasionally the wheat crops, are from fifty to one hundred bushels. They are supposed to be very serviceable to the two clover crops, and greatly beneficial to the succeeding wheat one, by some persons; but others are of quite the contrary opinion, thinking them of very little use to the wheat, except by increasing the quantity of the clover. They are also useful in destroying moss in the surface of grass lands. They are to be kept dry, and commonly sown over the crops in November or January in mild moist weather.

In Oxfordshire, peat-ashes are made use of from about twelve to forty bushels upon the acre; and those of coal from sixteen to upwards of fifty. They are sown over the wheat, clover, saintfoin, and turnip crops, the coal being somewhat the best on the clovers, and the peat on the turnips.

In Berkshire, peat-ashes are used very generally for most sorts of crops, except wheat, barley, and peas, either sown with the seeds and harrowed in together, or sown on the land as a top-dressing, only; but they are more preferred for all sorts of artificial grass crops, and on natural meadow and pasture grasses, as well as turnips. The quantities employed are from fifteen to twenty bushels and upwards on the acre. They are applied in March or April, several acres being capable of being sown in the course of the day. They only last about a couple of years in the land. The ashes of bean stubble are likewise found beneficial hereabouts, bringing up white clover when put upon the grass lands.

Different sorts of ashes have been found very useful on the grass lands in Sussex, at the rate of from twenty to thirty bushels on the acre, employed as a manure.

In Essex coal-ashes are laid upon the clover, saintfoin, and grass crops to the quantity of sixty bushels on the acre or more, with very great effects in promoting their increase.

In the county of Hertford they manure for turnips and some other crops with rabbit and poultry dungs, at the rates of from fifty to sixty bushels or more on the acre, with good success. And in some part of the Oxford district, pigeons' dung is found an excellent manure when thrown over the young barley crops, mixed with that of poultry. In Essex too, it is found beneficial for promoting seed when sown over the rape or cole crops in the proportion of eight bushels to the acre.

There are several other articles which are occasionally thrown over crops on the surface of the lands as a manure, in this intention, such as those of the dust of malt, rape-cake, bones, plaister of Paris, and some others. Malt-dust is made use of on wheat and barley in many parts of the county of Oxford, and on the young wheats in Hertfordshire, in the quantity of five quarters to the acre. In Berkshire thirty bushels *per* acre. Rape-cake dust is also used in the former of these last counties on the wheats with great success. Pounded bones are likewise greatly beneficial when strewed over the grass and some other sorts of crops, being sometimes a very forcing manure, and at the same time lasting. The plaister of Paris has been used on clover, saintfoin, lucern, and other crops with immense effect, in some parts of Oxfordshire, sown over them about March, to the quantity of six bushels *per* acre. But in Sussex, in the proportion of eight bushels to the acre, when sown over natural grass, bean, potatoe, pea, and barley crops, it had not the least good effect. Nor even when tried on other sorts in the quantity of six bushels to the same extent of land.

Powdered oil-cake that has been spoiled by keeping, is an excellent application as manure in the above way. The same is also the case with chopped tanners' hair, which has been found superior in this use to either malt-dust or any sort of calcareous matter. Horn-shavings are likewise very beneficial when laid on in this manner to grass lands, in the proportion of from fifty to one hundred bushels to the acre, lasting five or six years, and being of very easy carriage they should be employed in damp weather about February or March. See MANURE.

All these different sorts constitute excellent quick forcing manures, when applied in some of these ways for some of the above purposes, and should be much more generally employed in such methods than is at present the case.

Quick Match, in *Artillery*, is formed of three cotton strands drawn into length, and dipped in a boiling composition of white wine vinegar, saltpetre, and mealed powder. After this immersion, it is taken out hot, and laid in a trough where some mealed powder, moistened with spirits of wine, is thoroughly incorporated into the twists of the cotton, by rolling it therein: thus prepared, they are taken out separately and drawn through mealed powder, and then hung upon a line to dry. There is also quick match made of worsted instead of cotton. For its use, see *FIRE-Ships*.

Quick with Child, in *Law*. See *REPRIEVE*.

Quick Pulse, in *Medicine*. See *PULSE*.

Quick Sand, in *Sea Language*, denotes a loose quaking sand, into which a ship sinks by her own weight, as soon as the water retreats from her bottom. See *QUICKSAND*.

Quick Thorn, in *Agriculture*, a name frequently applied to young plants of the hawthorn or white-thorn kind, which are fit for being planted out for the purpose of forming a hedge-fence. See *QUICKS*, and *QUICKSET*.

It also signifies this sort of thorn generally.

QUICKEN TREE, in *Gardening*, the common name of a tree of the ornamental fruit kind. See *SORBUS*.

QUICKENING, in *Midwifery*, the first perception women have of the motion of the fœtus. This usually happens in the third or fourth month of pregnancy. It has puzzled physiologists to explain why the motion of the fœtus should not be perceived earlier, as it is endowed with life from the first moment of conception. But, besides that the parts of the fœtus are too soft and tender to affect the uterus by its motion, the membranes enveloping it are too thick, and there is then a proportionably larger quantity of fluid in the ovum than afterwards, which keeps the embryo from touching the sides of it. The uterus also during this period is confined in the cavity of the pelvis, which being of small capacity, and every way surrounded with bones, leaves little room for the motion of the fœtus. But as soon as the uterus emerges into the cavity of the abdomen, it readily yields to the motion of the inclosed fœtus, and the parts by which it is now surrounded being extremely delicate and sensible, they are affected by the slightest stirring of it. In some women of delicate habits, the moment of quickening is marked by a slight hysterical paroxysm. In these cases it seems probable, that the uterus has slipped suddenly into the abdomen, but ordinarily it rises slowly and gradually, whence the shock on the bowels is so inconsiderable, as scarcely to make any sensible impression. See *CONCEPTION*.

QUICKING-DRAW, in *Agriculture*, a name sometimes given in different districts to the couch and quitch drag. See *DRAW*.

QUICKJOCK, in *Geography*, a town of Sweden, in the Lapmark of Lutea; 15 miles N.W. of Lutea. N. lat. 67° 20'. E. long. 17°.

QUICKS,

QUICKS, in *Agriculture*, a name commonly given to the young sets of the white-thorn, which are used in planting hedges of that sort. See **QUICKSET-Hedge**.

It is thought to be indispensably necessary to the success of this sort of sets, as hedge plants, in every situation, that they be well provided with roots and root fibrils of the healthy kind, by Mr. Nichol, who has had much experience upon the subject. And that this is best secured by taking them from a seminary of rich mould at the end of the first or second year, according to their strength; and nursing them, after that, likewise in rich earth, for one or two seasons longer at the farthest: but, in the latter case, removing them into fresh rows at the end of the first year. It is contended, that plants of this age, and thus treated, will outgrow those of greater size in any sort of soil or situation. This has been repeatedly proved by impartial trials; and the cause, it is supposed, is obviously this, that small plants, even by the same treatment, are raised with better roots, in proportion to their stems, than large ones. Therefore in the choice of quicks, regard should be had to the roots, not the tops of the plants. Their being nursed the season previous to their being removed for hedging purposes, in rich mellow earth, and being allowed a sufficiency of room, kept clear of weeds and other matters, is the best mode of preparation, it is imagined, that can possibly be adopted.

There is, however, it is maintained, a double advantage in making use of young plants of this nature. They are cheaper and fitter for exposed situations than those of older growths; not because their tops are less bushy, which, since they are to be cut over about half their lengths before being planted, is immaterial, but because they have better proportioned roots to the size and strength of the stems, and of course are better fitted to seek pasturage for their common sustenance and support.

The stems of the plants, as has been suggested above, should be cut over about half their lengths, or, in general, about six inches above the ground mark: an operation which may be performed by the common hedge shears, a large sharp knife; or by gathering a handful of them evenly, and laying them upon a block or other similar body, and chopping them off by means of a hatchet. They should always be carefully raised, and even the smallest fibre be retained. And at all times, until replanted, the roots should be exposed as little as possible to the air or atmosphere. See **QUICKSET**.

QUICKS is also a term sometimes applied to the weed called couch-grass, in different places, and which is of a very troublesome nature, not being extirpated out of the land without much difficulty. See **COUCH**.

QUICKSAND, any sort of spot or bed of running sand, either near to the surface of the soil, or at any depth below it, which has a shaking quaggy feel under the foot at certain times or seasons, in consequence of containing certain proportions of water. The writer of the work on "Landed Property" has remarked, that they are for the most part topical, and in general only temporary, commonly appearing in and after wet seasons only; closing and becoming firm when their supplies of moisture are exhausted by long drought. In these cases the surfaces are free from the deposition of the moory earth of bog plants, which demand a constant coolness, if not a perpetual supply of moisture, being caused by heads or small beds of sand or gravel rising through firmer strata to the surface. They are of course apt to be scorched in dry hot seasons. In order to remove them, the same writer advises, that the centre of the part which is affected should be marked out

when the season is wet, in order that a drain may be cut, when it is dry, of a sufficient depth quite up to the mark, letting it have the necessary descent, and then filling it with suitable materials to admit of the water being conveyed off as it is collected in the sub-soil. When the defect has been thus removed, where it is situated in the area of a field, it is a good practice to cover the part by soil of the same nature as that of the field where it is situated, by bringing it from those parts which are the most elevated, as by this means it may be rendered of an uniform quality with the rest, and of course have a better appearance, as well as be more advantageous in the growth of crops.

Dangerous tracts and spots of this nature are frequently found in marshy and sandy lands, which are occasionally covered by the tides. And large deep beds or layers of quick or running sand are often met with in digging pits, quarries, mines, and other sorts of shafts, to great depths under the ground, and cause much trouble and difficulty in getting on with such kinds of work, on account of the quantities of water which they contain and let pass off into them: thus occasioning the necessity of much difficult drainage, and other inconveniences. See **QUARRIES**, *Pits*, &c. *Draining of*.

QUICKSAND Bay, in *Geography*, a bay on the west coast of North America. N. lat. 45° 50'. W. long. 124°.

QUICKSET, in *Agriculture*, a term generally applied to the white, or hawthorn plant, the sets or young plants of which are raised by nurserymen for sale, for the purpose of planting and forming hedge-fences. The roots of the thorn will, however, answer equally well, and in some cases much better, as there is a certainty of their being of the right sort, or such as have prickles upon them, which does not always happen in using the quicksets, as they are liable to disappear when raised in this method, but which is never the case in the root-mode. See **FENCE-Thorn**, and **WHITE-Thorn**.

Young plants of the quickset kind are best raised in small portions of ground set apart for them; in which, after they are come up from the seed to some height, they should be transplanted in lines at narrow distances, in a straight manner, with small intervals between the rows; where they are to remain from three to five years or more, being annually well cleaned and moulded up. Some, however, transplant them more than once, and think it an advantageous way, but they do well in either method. Well grown plants, with stout clean stems, are the most proper for planting out as hedge plants.

QUICKSET Hedge, a name given to all sorts of hedge-fences which are constituted of any sort of living plants; but more especially of those of the white-thorn kind. Hedges of this nature compose the principal fences of this country. In the drier and better sorts of soil, those of the thorn kind generally prevail; but in most other situations, those of some other sorts of plants, according to the particular nature of the soils and exposures. The quicks or quicksets of the thorn sorts are commonly supposed to form the best hedges, when planted in the raised bank or dike method. The manner of placing them out in these, is different in different cases, both in respect to the form and number of the rows, as well as the distances of the plants from each other. Some think one regular or irregular row the most proper, others prefer two straight ones; and some suppose a few inches distance from plant to plant the most beneficial; while others think eight or nine inches to be much better. Strong well-grown quicksets are commonly preferred in all cases. It is remarked in the Essex Report, by one of the persons engaged in drawing it up, that in the

parish of Birdbrook, in the north-east part of it, "some excellent hawthorn hedges have been lately raised, by planting one row only at six inches asunder, rather than two rows nine inches or a foot apart. The hedges have not been cut down, nor do they require it, to thicken their bottoms, as they are, at this time, a complete protection against hogs, and in other respects form a beautiful and effectual fence. Nothing can be more evident, it is thought, than that a row of plants set thus, ... six inches distant from each other, must form a more complete and effectual fence at the bottom, than an equal number planted thus, ... at a double distance, and occupying the same length, but a greater depth of ground upon the hedge row." This reasoning of Mr. Vancouver's, Mr. Young observes, may, for aught he certainly knows, be conclusive, but it strikes him in a different light. It is true, that the plants in each row are, in the latter mode, at double the distance from each other than they are in the former; but it is to be observed, that in the double row, the plants are diagonally as near each other as in the single row, and, consequently, there is the same vacant space for any animal to pass through in the single row as in the double; and what must be a great advantage to the latter, the plants will shoot out their branches laterally on the outwards at least, just as far as those in the single row, and twice as far lengthwise, meeting with no obstruction in their progress. Of course, it is naturally to be concluded, that the double-rowed plantation must form a fence, if not altogether twice as strong and secure, yet vastly stronger and securer than the single one. He does not, however, presume to set speculation against fact, as he has not seen the hedge noticed above, while Mr. Vancouver has. He has, however, himself planted one in a single row, as above described and recommended; the plants have grown well; the hedge is a good one, but would, he thinks, have been still better, if there had been two rows instead of one, as some others are that he has of that description.

In Suffex, the quickset hedges at Goodwood are capital, and deserving of every attention, being raised and trained in a most masterly manner. The duke of Richmond planted them about eighteen or twenty years ago. They surround a very considerable farm, and are in a wonderful state of preservation. They form an excellent fence, without the assistance of any ditch, bank, rail, or pale; consist of three rows of white-thorn plants, which spread three or four feet at bottom, but are clipped regularly and gradually to a thin edge at top; the shoots are so numerous, and trained with such care, that even in winter, without a leaf, the thickness is uncommon. By the young hedges now in training, it appears that one method pursued has been to plant the centre row first, and when that is well established, to add another on each side of it; at least this is done in these new hedges. They are kept in a state of garden cleanliness; the branches are drawn into the line desired, by being tied with mat, or other lines, and the clipping done with the exactest attention; the union of the hedges with the gate-posts is close and perfect, and as to gap, &c. there is no such thing. How they have been preserved from cattle, but especially from sheep, is marvellous, if either are ever allowed to enter these closes;—an attention never ceasing, and a boundless expence, so far as necessary, must have been exerted. They cannot be recommended to the imitation of farmers on account of the trouble and expence of them, but they are beautiful as an object to the farming eye, and for their perfection, they merit all that can be said of them.

On the Walburton farm in the same district, there are some very good quickset hedges, which were planted about twenty-three years ago; the quick was set about two inches

asunder, and single; they are cut twice in a year; are four and a half feet high, and two feet thick. There is very little ground lost by the hedge, as it occupies only four feet. The same excellent sort of quickset hedges has also been made in some other places.

Here two rows of white-thorn plants are common, which are put on the bank of the ditch, care being taken not to have them too near it, for fear of its draining them too much and preventing their growth.

In some districts, where the cultivation is principally of the arable or tillage kind, and in exposed upland situations, there is frequently a great prejudice and objection to the introduction and formation of any sort of live hedges, whether of the quickset or any other description, as they take up much space, harbour birds and insects, greatly shade the grain, and tend to promote blight, rust, and mildew, by preventing the free circulation of air. Also in bleak exposures they are not raised without great difficulty. Such objections, however, speedily vanish where they are kept sufficiently low and well cut in and trained on the sides. See HEDGE and FENCE.

QUICKSILVER, a very ponderous fluid mineral, by the chemists called *mercury*. For the method of gaining, preparing it, &c. with its properties, uses, &c. see MERCURY.

Quicksilver, when rubbed down and blended with unctuous matters, forms a sort of ointment, which is useful in the curing of different diseases of the cuticular kind, as well as in destroying lice and other vermin that infest animals of different kinds, which form the live-stock of the farmer.

It has also been stated on the authority of Mr. Bradford, as communicated to the Society for the Encouragement of Arts, &c. to have been found useful in its crude state in destroying insects on fruit trees. On a plum-tree he made the following trials: he took a small awl, and pierced, sloping, through the rind, and into part of the wood of the branch, but not to the heart or pith of it; and poured in a small drop or two of the quicksilver, and stoped it up with a small wooden plug, made to fit the orifice: and the result was, he says, that the insects all dropt off from that very branch the next day; and in a day or two more, from off the other branches of the tree, without any other puncture: and the tree continued in full vigour, and throve well all the summer after. Encouraged by this success, he next tried it upon an honeysuckle, the leaves of which were quite covered with them: and here he scraped away the top of the ground with a trowel, and run his awl in the same sloping manner, into the main stem, just above the roots; but with the same caution as above, not quite to the inner pith; and the success was the same as before. The insects all dropt off dead the next day after the experiment was made.

These trials are said to have been confirmed by other experiments; but they are still in want of full and satisfactory confirmation.

QUICKSILVER, *Virgin*. See VIRGIN.

QUICKSILVER *Water*. See WATER.

QUICKSTADT, in *Geography*, a town of Norway, in the province of Aggerhuus; 42 miles N. of Christiania.

QUICK-WORK, in a *Ship*, is a general name given to all that part of a ship which is under the surface of the water, when she is laden fit for a sea-voyage. The term is also applied, occasionally, to that part of the side which is above the sheer-rail, and which is usually painted with trophies, &c. on the outside. Falconer.

QUICK-WORK is likewise applied to the strakes that shut in the inside, between the spirkitting and clamps.

QUID,

QUID, *What*, in the *Schools*, is used to denote the definition of a thing.

It is thus called, because the definition answers to the question, *quid est? what is it?*

Hence we have two kinds of quids; nominal, *quid nominis*; and real, *quid rei*.

QUID juris clamat, in *Law*, a writ that lies where I grant the reversion of my tenant for life by fine in the king's court, and the tenant will not attorn; then the grantee shall have this writ to compel him.

This writ seems to be obsolete, since the fourth and fifth of Anne. See **ATTOURNMENT**.

QUID pro quo, q. d. *what for what*, denotes the giving one thing of value for another; or the mutual consideration and performance of both parties to a contract.

QUID pro quo, or **QUI pro quo**, is also used, in *Physic*, to express a mistake or cheat of an apothecary, in administering one medicine for another: or in using an ingredient in a composition different from that prescribed.

A northern physician, in a printed thesis on *quid pro quos*, owns ingenuously, that they are very frequent. He distinguishes very accurately a great variety of kinds of *quid pro quos*; some with regard to the operation, others with regard to the subject; and others with regard to their form, or effects. The first comprehends the *quid pro quos* of the physician; the second, those of the patient; the third, those of the apothecary.

QUID Læst, a term which signifies the loss of the ruminant power in animals of the live-stock kind. It is mostly produced by local weakness of the stomach, caused by eating improper coarse kinds of food in too large quantities, or other similar means. It may be best restored by the use of strong acids of the vegetable and other kinds, and its return prevented by strong bitter infusions, as those of gentian, bark, &c. See **CUP**.

QUIDDEINEN, in *Geography*, a town of Prussia, in Oberland; 6 miles S.E. of Holland.

QUIDDENY, **QUIDDANY**, (of the Latin *cydonium*, or *cydoniatum*,) a conserve of quinces, called also marmalade.

QUIDDITY, **QUIDDITAS**, in the *Schools*, a word of the same signification with *essence*.

The name is derived hence, that it is by the essence of a thing that it is *tale quid*, such a quid, or very thing, and not another. When upon seeing, or hearing, the name of a thing, with whose nature, &c. we are unacquainted, we ask, *Quid est? What is it?* we mean no more by the interrogation, but that we desire to have its nature and essence explained by a definition. Whence quiddity is usually defined the essence known or expressed in a definition.

And hence what is essential to a thing is said to be quidditive; as quidditive knowledge, &c.

QUIEBOU, in *Geography*, a town of France, in the department of the Channel; 6 miles S.W. of St. Lo.

QUIEN, **MICHAEL LE**, in *Biography*, a learned Dominican monk, who flourished in the latter part of the 17th and in the 18th century, was born in the year 1661. He received a liberal education, having been instructed in classical learning at his native place, and he was then sent to study philosophy at the college du Pleffis, at Paris. At twenty years of age he determined to renounce the world, and took the habit in a Dominican convent. Here he studied with uncommon assiduity and proportionate success, the Greek, Hebrew, and Arabic languages, criticism, divinity, the sacred scriptures, and ecclesiastical antiquities. In the year 1690 he first appeared as an author, by publishing "A Defence of the Hebrew Text and the Vulgate Version," against a work, entitled "The Antiquity of Time restored," written

by father Pezron. The latter having published a reply, Quien answered in a work entitled "The Antiquity of Time exploded." He next attacked him in "Remarks" on his "Attempt at a literal and historical Commentary on the Prophets," printed in the *Memoires de Trevoux*, for March 1711. During the following year he published "S. Joannis Damasceni Opera quæ extant Gr. et Lat." in 2 vols. fol. accompanied with dissertations abounding in erudition. He intended to have given a third volume, containing such pieces as had been falsely attributed to that father, but it was never sent to the press. The same fortune has attended his labours on "The Works of Leo of Byzantium," to which he had paid a considerable share of attention. Towards the close of his life he entered into a controversy with father Courayer, concerning the validity of the ordinations of the church of England, in which the palm of victory was given to his opponent. Le Quien died in 1733, at the age of 72 years, respected for his piety, and uniform correctness of conduct. He was author of various "Dissertations" to be found in *Desmolets* "Memoires de Literature et d'Histoire," and the "Mercure de France." At the time of his death he was engaged in printing the most considerable of his works, relating to the ancient and present state of the eastern churches. "His plan includes the whole of his churches, under the four grand patriarchates of Constantinople, Alexandria, Antioch, and Jerusalem; presents a geographical description of each diocese, and of the episcopal cities, and then gives a particular account of the origin and establishment of the churches, their extent, their jurisdiction, their rights, their prerogatives, the succession and order of their bishops, their political government, the changes which they have undergone," &c. As the author did not live to finish his work, it was published with additions, in the year 1740, under the title of "Michaelis le Quien Oriens Christianus, in quatuor Patriarchatus digestus, qua exhibentur Ecclesiæ, Patriarchæ, cæterique Presules Orientis," &c. in 3 vols. fol. Moreri.

QUIENFIORD, in *Geography*, a bay on the coast of Norway; 27 miles N. of Christianland.

QUIENS, a river of Norway, which runs into the sea, 18 miles N. of Cape Lindefnes.

QUIESCENT, something at rest.

QUIETISM, in *Ecclesiastical History*, the sentiments of the Quietists, a religious sect, which made a great noise towards the close of the 17th century.

Molinos, a Spanish priest, who died at Rome in the prison of the inquisition, passes for the author of Quietism; and yet the Illuminati in Spain had taught something like it before.

A sect similar to this had appeared at Mount Athos, in Thessaly, towards the close of the fourteenth century, under the appellation of Hesychasts, which denotes the same with Quietists. These were a branch of the *Mystics*, (which see,) or those more perfect monks, who, by a long course of intense contemplation, endeavoured to arrive at a tranquillity of mind entirely free from every degree of tumult and perturbation. These Quietists, in conformity to an ancient opinion of their principal doctors, (who imagined that there was a celestial light concealed in the deepest retirements of the mind,) used to sit every day, during a certain space of time, in a solitary corner, with their eyes eagerly and immoveably fixed upon the middle region of the belly, or navel; and boasted, that, while they remained in this posture, they found, in effect, a divine light beaming forth from the soul, which diffused through their hearts inexpressible sensations of pleasure and delight. To such as inquired what kind of light this was, they replied, by way of illustration, that it was the glory of God, the same celestial radiance that surrounded

Christ during his transfiguration on the mount. Barlaam, a monk of Calabria, from whom the Barlaamites derived their denomination, styled the monks, who adhered to this institution, Massilians and Euchites : and he gave them also the new name of Umbilicani. Gregory Palamas, archbishop of Thessalonica, defended their cause against Barlaam, who was condemned in a council held at Constantinople in the year 1341.

The name is taken from a sort of absolute rest, and inaction, which the soul is supposed to be in, when arrived at the state of perfection, which in their language is called *the unitive life*. To arrive at this, a man is first to pass through the purgative way ; that is, through a course of obedience, inspired by the fear of hell : hence he is to proceed into the illuminative way, before he arrives at perfection.

The sentiments of the Quietists, with regard to God, are wonderfully pure and disinterested. They love him for himself, on account of his own perfections, independently of any rewards or punishments : the soul acquiesces in the will of God, even at the time when he precipitates it into hell ; inasmuch that instead of stopping him on this occasion, B. Angelo de Foligny cried out, "Haste, Lord, to call me into hell : do not delay if thou hast abandoned me : but finish my destruction, and plunge me into the abyss."

At length the soul, after long travail, enters into rest, into a perfect quietude. Here it is wholly employed in contemplating its God ; it acts no more, thinks no more, desires no more ; but lies perfectly open, and at large, to receive the grace of God, who by means thereof drives it where it will, and as it will.

In this state it no longer needs prayers, or hymns, or vows ; prayers where the spirit labours, and the mouth opens, are the lot of the weak, and the imperfect : the soul of the faint is, as it were, laid in the bosom, and between the arms of its God, where, without making any motion, or exerting any action, it waits, and receives the divine graces. It then becomes happy : quitting the existence it before had, it is now changed ; it is transformed, and, as it were, sunk and swallowed up in the Divine Being, inasmuch as not to know or perceive its being distinguished from God himself. Fenel. Max. des Saints.

QUIETISTS, the disciples of Mich. de Molinos ; or the adherents to the opinions delivered in the article QUIETISM. The sentiments of Molinos were contained in a book, which he published at Rome in the year 1681, under the title of the "Spiritual Guide : " in consequence of which he was cast into prison in 1685, where he was soon obliged to renounce, in a public manner, the errors of which he was accused : and this solemn recantation was nevertheless followed by a sentence of perpetual imprisonment, from which he was in an advanced age delivered by death, in the year 1696. Molinos had a considerable number of disciples in Italy, Spain, France, and the Netherlands. One of the principal patrons and propagators of Quietism in France, was Marie Bouvieres de la Mothe Guyon, a woman of fashion, remarkable for the goodness of her heart, and the regularity of her manners ; but of an unsettled temper, and subject to be drawn away by the seduction of a warm and unbridled fancy. This female apostle of mysticism derived all her ideas of religion from the feelings of her own heart, and described its nature to others as she felt it herself. Accordingly, her religious sentiments made a great noise in the year 1687 ; and they were pronounced unsound, after accurate examination by several men of eminent piety and learning, and professedly confuted, in the year 1697, by the celebrated Bossuet. Hence arose a controversy of great moment, between the prelate last mentioned, and Fenelon, arch-

bishop of Cambray, who seemed disposed to favour the religious system of Madame Guyon, and who, in 1697, published a book, cited in the last article, containing several of her tenets. Fenelon's book, by the interest of Bossuet, was condemned in the year 1699, by Innocent XII. and the sentence of condemnation was read by Fenelon himself at Cambray, who exhorted the people to respect and obey the papal decree. Notwithstanding this seeming acquiescence, the archbishop persisted, to the end of his days, in the sentiments which, in obedience to the order of the pope, he retracted and condemned in a public manner. See the article FENELON.

QUIETO, in *Geography*, a river of Istria, which runs into the Adriatic, two miles W. of Bastia.

QUIETUS, *freed or acquitted*, a term used by the clerk of the pipe, and the auditors in the exchequer, in their acquittances or discharges given to accountants, which usually conclude with the words *abinde recessit quietus* ; which is called a *quietus est*.

A *quietus est* granted to a sheriff, discharges him of all accounts due to the king.

QUIFORO, in *Geography*, a district of Africa, on the Gold Coast.

QUIGNONES, FRANCIS DE, in *Biography*, an eminent Spanish cardinal in the 16th century, who embraced the religious life at an early age, in a monastery of Franciscans, and subsequently afforded such evidence of superior talents, that he was elected general of his order in the year 1522. He obtained the office of confessor to Charles V. and upon the capture of Rome by the imperial army in 1527, and the imprisonment of pope Clement VII. in the castle of St. Angelo, his services were solicited by that pontiff, in negotiating for his liberty, and were afterwards rewarded with a cardinal's hat. After this, he was by the same interest nominated bishop of Caunia, and sent in the capacity of apostolical legate into Spain, and the kingdom of Naples. He died in the year 1540. He was author of a reformed breviary printed at Rome in 1536, which met with the approbation of popes Clement VII. and Paul III. but it was afterwards suppressed by Pius V. ; hence it has become scarce, and is sought after by collectors. Several spurious editions have been printed at different times. It is inserted in the "Annales Minores" of Wadingus, and in the second edition of Joly's treatise "De Reformandis Horis Canonicis."

QUIJUBATUI, in *Ornithology*, the name of an American species of paroquette.

It is of the size of a lark, and in general of a yellow colour. Its eyes are black, and its beak grey. The edges of its wings are of a dusky green, and its tail long and yellow. It is a very beautiful bird, and very easily tamed. See PSITTACUS *Guarouba*.

QUIKNE, in *Geography*, a town of Norway, in the province of Bergen ; 105 miles N. of Christiania.

QUIL, in *Zoology*. See QUIRPELE, and VIVERRA *Mungo*.

QUILAQUIL, in *Ornithology*, the name given by the people of the Philippine islands to a very beautiful species of parrots, which is commonly found wild in the woods there. It is all over of a fine green colour, and is smaller than the common parrots, and has a broad black bill, and black legs. It is a very wild bird, and will not learn any thing.

QUILATE, in Spanish and Portuguese *Coinage*, a term used for *carat* ; which see.

QUILEA, in *Geography*, a sea-port town of Peru, near the Pacific ocean, which gives name to a fertile valley, in the jurisdiction of Arequipa. S. lat. 16° 45'.

QUILICI,

QUILICI, GAETANO, in *Biography*, an Italian opera-finger, with a base voice: a good musician, who arrived here in 1759, during the performance and opera regency of the Mattei. He continued to perform on our lyric stage near thirty years, and is, we believe, still living in London, we fear, in penury and obscurity. Since quitting the stage, he has supported himself, a bed-ridden wife, and an idiot son, by teaching to sing, and has made some admirable scholars.

QUILIMANCY, in *Geography*, a river of Africa, which runs into the Indian sea, 20 miles S. of Melinda. S. lat. $3^{\circ} 16'$. E. long. $40^{\circ} 10'$.—Also, a sea-port town of Africa, in the kingdom of Melinda, at the mouth of the before-mentioned river, belonging to the Portuguese. S. lat. $3^{\circ} 10'$.

QUILIMANE, a town of Africa, in Mozambique. S. lat. $18^{\circ} 15'$. E. long. $37^{\circ} 30'$.

QUILLAJA, in *Botany*, a genus of plants found in Chili, and described by Molina. Juss. 444. Lamarek Illustr. t. 774.—Class and order, *Monoeceia Dodecandria*. Nat. Ord. uncertain.

Ess. Ch. Male. Calyx five-cleft. Corolla none. Stamens twelve, or more.

Female, Calyx five-cleft. Corolla none. Germens five, superior, opposite to the segments of the calyx. Styles five. Capsules five, coriaceous, of two valves, and one cell. Seeds numerous, oblong, inserted into the bottom of the capsule, dilated and winged at the summit.

Such is the character made out by Jussieu, from the publications of Molina and Frezier, and from specimens of the fruit, brought to Europe by Dombey. They belong to a tree, whose bark has a soapy quality. The leaves are alternate, simple, evergreen. Flowers axillary.—The genus appears akin to the *Magnolia* of Jussieu, but whatever it may be, the name is barbarous and quite inadmissible; only tolerable for a time, till some botanist, furnished with better materials to define the genus, shall be entitled to give it a more classical appellation. Jussieu remarks, that another plant of Dombey's appears to belong to the above genus. This is a tree referred by him to *Dioecia Icsofandria*, whose fruit is called *Gayo colorado*, and which is the same with the "*Loque*, or Peruvian tree with five capsules," of Joseph de Jussieu, whose branches, according to his manuscript account, are so long and pliant, as to be twisted into cords, serving, in the province of Cusco, for the support of hanging bridges.

QUILLALA, in *Geography*, a town of Chili, on the Aconcagua; 30 miles E.N.E. of Valparaiso.

QUILLAN, a town of France, in the department of the Aude, and chief place of a canton, in the district of Limoux; 10 miles S. of Limoux. The place contains 1568, and the canton 9195 inhabitants, on a territory of $272\frac{1}{2}$ kilometres, in 22 communes. N. lat. $42^{\circ} 52'$. E. long. $2^{\circ} 16'$.

QUILLA-YACU, a town of Peru, in the diocese of Lima; 60 miles E.N.E. of Guano.

QUILLE, a town of Sweden, in West Gothland; 23 miles N. of Uddevalla.

QUILLEBEUF, a town of France, in the department of the Eure, and chief place of a canton, in the district of Pontaudemer, seated on the Seine; eight miles N. of Pontaudemer. The place contains 1200, and the canton 7272 inhabitants, on a territory of $107\frac{1}{2}$ kilometres, in 16 communes. N. lat. $49^{\circ} 29'$. E. long. $0^{\circ} 38'$.

QUILLET, CLAUDE, in *Biography*, born at Chinon, in Touraine, about the year 1602, was brought up to medicine, which he practised some years, till he was obliged to

quit the country on account of his opposition to a measure of Richelieu, which is thus narrated. Quillet was at Loudun at the time that Loubardemont, a creature of the cardinal, was sent thither to take informations respecting the pretended possession of some nuns by the forceries of Urban GRANDIER (see his article), an imposture which Richelieu thought fit to favour. The counterfeit Satan one day threatened, that on the morrow he would lift up to the roof of the church any one who should presume to call his power in question. A large company appeared on the next day with M. Loubardemont, when Quillet, who also was present, challenged the devil to keep his word. To the surprise of the superstitious who had met on the occasion, nothing followed, but the challenger found to his cost that he had given offence to a mightier power than Satan, and felt it necessary to quit Loudun in haste, and retire to Italy. He went to Rome, and was engaged as secretary to the French ambassador at that court. He probably returned to France with that minister, after the death of Richelieu, and in 1655 he published at Leyden, under the name of Calvidius Lætus, the poem by which he is chiefly known, entitled "Callipædia sive de pulchræ Proles habendæ ratione." In the first edition were some satirical lines against Mazarin. The cardinal sent for him, and having gently remonstrated with him for treating his friends with severity, promised to give him the first vacant abbey. Quillet threw himself at the cardinal's feet, asked pardon, assured him he would instantly obliterate the offensive lines, and begged, as a sign of his penitence, to be allowed to dedicate the poem to him. This was done in the Paris edition of 1656, and Quillet became the flatterer of him who had been the object of his satire. He died at Paris in 1661, repenting not of his adulation, but of the licentious cast of some of his verses. The Callipædia has gone through many editions, and has been translated into various languages. "It is," says an able critic, "an ingenious performance, agreeably varied by fable and episode, but frivolous in its main topic, and in its reasonings. Its details are frequently loose and inflammatory, and that a cardinal should have allowed it to have been dedicated to him, is a proof how little regard was paid, at that period, to the rules of decorum. The versification, though generally free and flowing, is by no means correct, and the diction is frequently impure." Quillet composed a version of Juvenal in French verse, and a Latin poem in twelve books, entitled "Henriados," or the actions of Henry IV. This, with other papers, he left to Menage, with 500 crowns to defray the charge of printing them, but the abbe took the money, and neglected the conditions.

QUILLIGA, in *Geography*, a country of Africa, in Upper Guinea, near the river Maqualbary.

QUILLOBO, in *Botany*, a name given by some to a species of ketmia, called also *quingombo*.

QUILLOT, KILLO, or Kylo, in *Commerce*, a Turkish corn measure, weighing, in wheat, about 23 okes, or 60lbs. avoirdupois: 4 killos make 1 fortin; $8\frac{1}{2}$ killos answer nearly to 1 English quarter. A killo of rice contains 10 okes, and the oke is 400 drachms.

QUILLOTA, in *Geography*, a town and jurisdiction of Chili. The town does not contain above 100 families, but those scattered over the country exceed 1000.

QUILLY, a town of France, in the department of the Lower Loire; 7 miles N. of Savenay.

QUILOA, a country and kingdom of Africa, situated near the east coast, near the mouth of the Coavo, about 180 miles from north to south; but the extent inland towards the west is unknown. This country was first discovered by the Portuguese, in the year 1498. The king and his subjects

jects are Mahometans; the latter partly black and partly tawny. They all speak the Arabic and several other languages, which they learn from the nations they traffic with. Their dress is that of the Arabian Turks: the women especially affect finery, with variety of ornaments about their necks, arms, wrists, and ankles; particularly bracelets made of ivory, curiously wrought, which upon the death of a parent, husband, or near relation, they break in pieces, in token of sorrow, whilst the men express theirs by shaving their hair, and abstaining from food. The capital of the kingdom is situated on an island near the mouth of the Coavo, and is said to be large, rich, and well built. The houses are of stone and mortar, handsome, and after the Spanish manner. They are several stories high, and have each a pleasant garden behind, well watered and cultivated, here being plenty of springs of fresh water. The houses are finely furnished within, and terraces on the top, with a kind of hard clay, and the streets so narrow, that one may easily step from one side to the other. On one side of the town is the citadel, where resides the Mahometan prince. It is adorned with stately towers, and surrounded with a ditch and other fortifications. It hath two gates, one towards the port, whence one may see the ships sailing in and out; the other looking towards the land. The country about Quiloa, though low, is yet very pleasant and fertile in rice and millet, fruits and good pasture; so that they breed abundance of cattle, besides poultry of all sorts, both wild and tame. They have fish likewise in great plenty, and very good. The climate is likewise affirmed by most travellers to be very temperate and healthy; Sanut being the only author we know of who hath ventured to assert the contrary in all these respects. S. lat. $8^{\circ} 35'$.

QUILONNE, a province of Africa, in the kingdom of Sabia.

QUILOVIA, a small island in the Indian sea, near the coast of Africa. S. lat. 13° .

QUILTAINEN, a town of Prussia, in the province of Oberland; 8 miles S.E. of Holland.

QUILTAON, one of the Laccadive islands, in the Indian sea. N. lat. 12° . W. long. $72^{\circ} 45'$.

QUILTING denotes the operation of weaving a sort of coat or texture, formed of the strands of rope, about the outside of any vessel, to contain water, &c. as a jar, cask, bottle, &c.

QUIMICHPATLAN, in Zoology. See *SCIURUS Volucella*.

QUIMINATIN, in Geography, a small island in the sea of Mindoro. N. lat. $10^{\circ} 55'$. E. long. $120^{\circ} 40'$.

QUIMIRI, a town of Peru, in the diocese of Lima; 40 miles N.E. of Nasca.

QUIMO, a small island on the east side of the gulf of Bothnia. N. lat. $63^{\circ} 17'$. E. long. $21^{\circ} 52'$.

QUIMPER, a city of France, capital of the department of Finistère, and chief place of a district, seated on the Oder; before the revolution the see of a bishop, the seat of a governor, an admiralty, &c. The place contains 6608, the canton 17,028 inhabitants, on a territory of 90 kilometres, in seven communes. N. lat. $47^{\circ} 59'$. W. long. $4^{\circ} 1'$.

QUIMPERLE, a town of France, and chief place of a district, in the department of the Finistère. The place contains 4162, and the canton 9128 inhabitants, on a territory of 125 kilometres, in 15 communes.

QUIN, Dr., of Dublin, in Biography, an eminent physician, and one of the most enlightened dilettante musicians with whom we have ever been acquainted. This gentleman, who, during his travels, resided in Italy some years, had

heard and studied music with such taste and intelligence, that his opinions and conversation on the subject were equally entertaining and instructive. He resided in Dublin at the time of Handel's arrival in that city, 1742, and perfectly remembering his performance, person, and manners, in 1788 wrote us word, that "he (Handel) was received in Ireland by persons of the first distinction with all possible marks of esteem, as a man, and admiration as a performer and composer of the highest order." And adds, "the Messiah, I am thoroughly convinced, was performed in Dublin for the first time, and with the greatest applause. Mrs. Cibber and signora Avolio were the principal performers. These, with the assistance of the chorists of St. Patrick's cathedral and Christ-church, formed the vocal band; and Dubourg, with several good instrumental performers, composed a very respectable orchestra. There were many noble families here, with whom Mr. Handel lived in the utmost degree of friendship and familiarity. Mrs. Vernon, a German lady, who came over with king George I. was particularly intimate with him, and at her house I had the pleasure of seeing and conversing with Mr. Handel; who, with his other excellencies, was possessed of a great stock of humour; no man ever told a story with more. But it was requisite for the hearer to have a competent knowledge of at least four languages: English, French, Italian and German; for in his narratives he made use of them all."

QUIN, JAMES, was born in London in 1693. He was the son of an Irish gentleman, and received his education in the capital of that country. His father had, ignorantly, married a woman supposed to be a widow; whose husband, after a long absence, returned and claimed her. The subject of this article was the offspring of this connection, and was accordingly illegitimated, and upon his father's death, in 1710, was left almost destitute. For want of education he was, at the age of twenty-one, without a profession, and was under the necessity of appearing on the stage at Dublin, in the very lowest characters. He displayed, however, rising talents, which induced a friend to advise him to attempt some better parts in London, and he was accordingly admitted into Drury-lane company in 1715. After the experience of a year or two, he entered himself under Rich at Lincoln's-Inn theatre, where he continued to perform during seventeen years. He was allowed, by the most competent judges, to shine both in tragedy and comedy. His utterance was weighty and impressive, which, however, was accompanied with various defects. He was, from causes not well ascertained, continually changing from one theatre to another, and perhaps he may be ranked among that number with whom it was difficult to keep terms. His passions were strong, his temper irritable, and his language often coarse. He was of convivial habits, and, it has been said, grossly attached to the pleasures of the table. There was, however, a fund of generosity in his temper, which shewed itself in many sentiments, and, occasionally, in benevolent actions. The circumstance of his giving a 100*l.* to the poet Thomson, when he was under an arrest for debt, has often been told to his honour. It was the commencement of a strong friendship between them. After Thomson's death, he appeared in that poet's tragedy of Coriolanus, and spoke a prologue, written on the occasion by lord Lyttleton, with a pathos that did honour to his feelings. His last performance was the favourite part of Falstaff, for the benefit of his friend Ryan in 1753. He now retired to Bath, where his fund of anecdote, and strong pointed sense, rendered his company much sought after. He had good breeding, which fitted him for the highest societies, when he chose to act the gentleman; and his sensuality and coarseness were frequently

frequently put up with for the sake of his companionable qualities. Quin died at Bath in 1766, at the age of seventy-three. Garrick, whose superior talents are supposed to have driven him from the stage, but afterwards his steady friend, wrote a poetical epitaph for his monument. While Quin continued on the stage, he constantly kept company with the most celebrated geniuses of the age. He was on intimate terms with Pope and Swift; and was frequently invited by the earl of Chesterfield to his table. His peculiar judgment in the English language recommended him to his royal highness, Frederic prince of Wales, who appointed him to instruct his children in speaking and reading with graceful propriety. When Quin was informed of the elegant manner in which his present majesty had delivered his first gracious speech from the throne, he was in raptures, and the king soon after gave orders, without any application on the part of Quin or his friends, that a genteel pension should be paid him during his life.

QUIN, in *Geography*, a village of the county of Clare, Ireland, where are the remains of a monastery, which was founded for Franciscan friars in 1402, and repaired by the Roman Catholics in 1604. Bishop Pococke speaks of it as one of the finest and most entire monasteries he saw in Ireland. It is situated on a fine stream, with an ascent of several steps to the church: at the entrance one is surprised with the view of the high altar, entire, and of an altar on each side of the arch of the chancel. The building is quadrangular, with piazzas supported by a number of pillars; there are apartments on three sides of the cloisters, with a vaulted room under them all. A round tower and some other ruins are adjoining. Quin is 15 miles from Limerick, on the road to Galway, and about 106 miles W.S.W. from Dublin. Archdall's *Monasticon*. Carlisle.

QUINA FOLIA, in *Botany*. See LEAF.

QUINABAUG, in *Geography*, a river of America, formerly called "Mobegan," which rises in Brimfield, Massachusetts, and is joined at Oxford by French river, which has its source in Sutton, Worcester county. It runs a southerly course, and discharges itself into Shetucket, about three miles above Norwich Landing, in Connecticut. In the first part of its course it furnishes many good mill-seats: as it advances, the intervals in many places are wide, and afford a most excellent soil.

QUINA-QUINA, in *Botany*, a Peruvian name, generally applied to the Peruvian bark. (See CINCHONA.) Justieu, however, in his *Gen. Pl.* 366, informs us, that it properly belongs to a tree, nearly if not entirely agreeing in genus with *Myrospermum* of Jacquin, or *MYROXYLON* of Linnæus. (See the last-named article.) An account of the *Quina-quina* may be found in the *Memoires de l'Acad. des Sciences* for 1738, p. 237.

QUINARIA, so called by Loureiro, *Fl. Cochinch.* v. 1. 272, from the prevalence of the number five in the parts of fructification, is the *Wampse* or *Wampi* of the Chinese, now established as a genus by the name of *COCKIA*. (See that article.) This plant passed long in the gardens of England, for *Guarea trichilioides*, according to the observation of the late Mr. Dryander.

QUINARIUS, QUINARY, in *Antiquity*, a little Roman coin, equal to half the denarius. See COIN.

The quinarius was properly the Roman halfpenny.

Medalists indeed use the term quinarius in the general for a medal of any matter, not exceeding the size of our sixpence; but F. Chamillart, in an express dissertation, shews this to be an abuse. The silver coins, current under the republic, he shews, were two: the one weighing a drachm, and called denarius, as containing ten asses; the other

weighing half a drachm, and called quinarius, as containing five asses: which coins continued on the same footing under the emperors.

Hence the origin of the word quinarius: and hence, in propriety, it is only the silver medal of the weight of half a drachm that the name belongs to; the Romans having never given it to any other species of the same size with it. It is only by way of analogy, therefore, that the moderns apply it to the medals of gold, or copper, of the same size with the silver quinarius; those of gold being fixed at a value much above, and those of brass much below five asses.

The only relation between these quinarii is, that the gold quinary is the half of a gold medal, as to weight and value; and the brass quinary half a brass medal, as the silver quinary is half a silver one.

Hence a series of quinaries should seem at least a necessary in the cabinets of the curious, as the series of great medals; they being all equally different species of money, which teach us how many kinds of pieces there were of any metal current in commerce.

Add to this, says our author, that the quinaries were of a finer and more finished coin than the other medals, being wrought by the hands of the masters; which seems owing to the nicety required in engraving whole figures in so small a compass. He adds, that though quinaries are very scarce, yet M. the duke of Maine had almost a complete set of them.

QUINAULT, PHILIP, in *Biography*, a French poet, was born in 1636, probably in a low condition; though while some say he was the son of a baker, others maintain that he was descended from a family of consequence at Paris. He had, however, very few advantages of education, but was soon found to possess a talent for poetry and the belles lettres. Before the age of twenty he brought out some pieces on the stage; and for a number of years, he continued to produce dramatic works of different kinds, which were much applauded by the public voice; but some of which drew upon the author the fatires of Boileau, who carried the matter so far as to injure his own reputation. Quinault now associated himself with Lulli in the composition of operas, and displayed an excellence in lyric poetry, or that adapted to music, which placed him beyond competition in that branch, and has ranked him among the distinguished characters of the age of Lewis XIV. Nothing, it is allowed, can be more tender, delicate, and ingenious, than the turn of his songs and love-dialogues; and no one has more happily accommodated the melody of French verse to musical expression. His "Armida" and his "Attilys" are spoken of as master-pieces of their kind. Notwithstanding the high reputation which he enjoyed as a poet, he applied himself to the study of the law, and eventually made his fortune by marrying the rich widow of a merchant, to whom he had been useful in his profession. After this, he purchased the place of an auditor in the chamber of accounts. He was received into the French academy, and, in the name of that society, harangued the king on his return from the campaigns of 1675 and 1677. He died in 1688, having enjoyed a pension from Lewis XIV. several years previously to his decease. In his last illness he was extremely penitent, on account of his having devoted his talents too frequently to the excitement of the licentious passions. He left a family of five daughters, and was esteemed in society attentive, polite, and mild. Besides his numerous pieces for the stage, he wrote occasional poems. His works were printed at Paris in 5 vols. 12mo., 1739, and again in 1778.

It has been said that Quinault's apprenticeship to poetry was served under Trifan l'Hermite, by being his domestic. The lessons of Trifan were probably of some use to him, as that author had had long experience in theatrical matters; but Quinault owed still more to nature: as before he was twenty years old, he had distinguished himself by several pieces for the stage, which had considerable success: and before he was thirty, he produced sixteen dramas, some of which were well received by the pit; but not all equally. It is supposed that some of these early pieces prejudiced Boileau against Quinault early in his career. There was neither regularity in the plan, nor force in the style: romantic lovers and common-place gallantry, in scenes which required a nervous pencil and vigorous colouring. These were defects not likely to escape the lash of the French Juvenal. He covered the young poet with ridicule; reproached him with the affectedly soft and languishing dialogue of his lovers, by whom even *I hate you* was said tenderly.

Quinault, born with great sensibility, was so wounded by his severity, that he applied to the magistrates, not only to silence Boileau, but oblige him to remove his name from his satires; but the attempt was vain. His enemy insulted him still more cruelly by an epigram on the subject.

"—Peace! peace! my friend—

If from the public thou'dst avoid disgrace,
From thy own works, not mine, thy name efface."

It was not till after Quinault was enlisted by Lulli to write for the opera, that he silenced all his enemies, except Boileau and his party, who envied him his success. The French nation knew no better music than that of Lulli, and thought it divine. Quinault's was thought of secondary merit, till after his decease; and then, in proportion as the glory of Lulli faded, that of Quinault increased. Voltaire, in the first edition of his "*Siecle de Louis Quatorze*," in 1749, seems to have been the first who spoke out on the subject; not sorry, perhaps, to lower Boileau a little in the eyes of the public. He there says, that "Quinault was celebrated for his beautiful lyric poetry, and for the gentleness with which he opposed the unjust satires of Boileau. His poetry was greatly superior to the music of Lulli. It will always be read; and Lulli, except in a few of his recitatives, can no longer be supported. However, it was long believed that Quinault entirely owed his favour to Lulli. Time appreciates all things."

After this, his writings began to be examined and felt; and of late years, his name is never mentioned by his countrymen without eulogy. His operas, though admirable to read, are ill calculated for modern music; and are obliged to be new written, ere they can be new set, even in France. Marmontel, who had modernized several of them for Piccini to set in 1788, gave M. Laborde a dissertation on the dramatic writings of Quinault for music; which is published in the fourth volume of his "*Essai sur la Musique*."

He begins by asserting that Quinault was the creator of the French opera upon the most beautiful idea that could be conceived; an idea which he had realized with a superiority of talent, which no writer has since approached.

His design was to form an exhibition, composed of the prodigies of all the arts; to unite on the same stage all that can interest the mind, the imagination, and the senses. And this illusive theatre Voltaire has admirably described:

"Il faut se rendre à palais magique," &c.

"Haste to the magic palace, where abound
The joys sublime of verse, of dance, and sound:

Where bright illusion fascinates the sight,
And fire-notes the enchanted ear delight;
Where all the plastic powers of art are shewn,
And joys unnumber'd are combin'd in one."

For this purpose a species of tragedy is necessary, that shall be sufficiently touching to move, but not so austere as to refuse the enchantments of the arts that are necessary to embellish it. Historical tragedy, in its majestic and gloomy simplicity, cannot be sung with any degree of probability, nor mixed with festivals and dances, or be rendered susceptible of that variety, magnificence, show, and decoration, where the painter and the machinist ought to exhibit their enchantments.

In Italy, where genuine tragedy has no theatre appropriated to its use, a people passionate for music have permitted Regulus, Themistocles, Alexander, and even Cato himself, to utter their speeches in song; but a people, whose taste ought to be more severe, and more delicate, as to probability, having for comparison the school of Corneille and Racine, would have been very unwilling to substitute the recitative of Lulli to the declamation of Baron. Melody itself is a fabulous and magical language; and in a theatre "where all is prodigy, it seems consistent that the manner of speaking should be that of enchantment as well as the rest. We are then in a new world: it is nature enchanted, and visibly animated by a crowd of intelligences, whose wills are laws. Music there plays a marvellous part; music there constitutes the probability of the marvellous; but in a representation where all passes for natural, according to truth and history, by what means can we be prepared to hear Augustus, Cornelia, Agrippina, or Brutus sing?" Might it not be replied, "By the same means as the French are reconciled to these same exalted characters conversing in rhyme." When once it is settled that all the characters converse in a musical language, no other is expected, and the audience is soon reconciled to it. But all this is to prove that the French alone are right, and Italy and all the rest of the world wrong as to the musical drama. The rest of Europe is tired and ashamed of flying gods and goddesses, and have long since surrendered mythological wonders both in poetry and music to their children. But all people are thought barbarians, who do not implicitly adopt the taste and fashions of France.

But to return to Quinault, whom all the wits of the time tried to write down. Ignorant of music and its powers, they thought Lulli always right, and the poor, modest, unpretending Quinault always wrong. Posterity has long discovered the converse of this supposition to be the truth. Quinault's great mistake and misfortune, says La Harpe, was the calling his pieces tragedies, and not operas. He would not then have been regarded as a rival of Racine, or have offended classical hearers or readers with the little resemblance these compositions had to Greek and Roman dramas, or to the genuine tragedies of the moderns.

QUINCE TREE, in *Gardening*, the common name of a tree of the apple kind. See *PYRUS Cydonia*.

QUINCE, in the *Materia Medica*. The fruit of the quince is astringent and stomachic; and its expressed juice, in small quantities, as a spoonful or two, is of considerable service in nausea, vomitings, nidorous eructations, and some kinds of alvine fluxes. This juice was formerly ordered in the Lond. Pharm. to be made into a syrup, called "syrupus cydoniarum," or syrup of quinces, prepared by digesting three pints of the depurated juice with a drachm of cinnamon, half a drachm of ginger, and half a drachm of cloves, on warm ashes.

ashes, for six hours, then adding a pint of red port, and dissolving in the strained liquor nine pounds of sugar. But the only preparation of the quince which it now directs is, a mucilage of the seeds, made by boiling a drachm of the seeds in eight ounces of water, till it acquires a proper consistence. This has been recommended in aphthous affections, and excoriations of the mouth and fauces: however, though it may be a more pleasant mucilage, it is certainly less efficacious than that of the simple quince. Lewis and Woodville.

A useful restraining marmalade is made by boiling the juice with fine sugar to a due consistence, in the proportion commonly of three pints to a pound. The juice of quinces becomes richer, by keeping them for some time, after they are gathered, in a dry airy place.

QUINCE *Island*, in *Geography*, a small island near the S.W. coast of Ireland, and county of Cork; five miles W. of Gally-Head.

QUINCHAC, a small island in the Pacific ocean, between the island of Chiloe and the continent of Chili. S. lat. $43^{\circ} 30'$.

QUINCHAMALA, in *Botany*, altered by Willdenow, one can scarcely see with what reason or advantage, from *Quinchamalium* of Jussieu, a barbarous and totally exceptionable name, taken from the Peruvian *Quinchamali*.—Willd. Sp. Pl. v. 1. 1217. Mart. Mill. Dict. v. 4. Jul. 75. Lamarek Illustr. t. 142.—Class and order, *Pentandria Monogynia*. Nat. Ord. *Elæagni*, Juss. Rather perhaps *Rubiaceæ*.

Gen. Ch. *Cal.* Perianth superior, of one leaf, in four deep, ovate, unequal segments, one larger than the rest. *Cor.* of one petal; tube funnel-shaped, much longer than the calyx, quadrangular, curved; limb in five lanceolate, acute, spreading segments. *Stam.* Filaments five, very short, inserted into the top of the tube; anthers oblong, the length of the limb. *Pist.* Germen roundish; style thread-shaped, the length of the tube; stigma capitate. *Peric.* Berry (rather drupa) roundish. *Seed* solitary.

Eff. Ch. Calyx in four unequal segments, superior. Corolla funnel-shaped, five-cleft. Stigma capitate, undivided. Drupa dry.

1. *Q. chilensis*. Willd. n. 1. (*Quinchamali lini folio*; Feuillée *Plantes Médicinales*, 57. t. 44.)—Gathered by Feuillée on the mountains of Chili, and by Dombey, among stones on the hills about Lima, flowering in December and January. The root is annual, composed of a few simple yellow fibres. *Stems* several, prostrate, simple, round, leafy, from four to six inches long. *Leaves* scattered, sessile, linear, entire, fleshy, smooth, bluntish with a small point. *Flowers* in simple, terminal, solitary, dense spikes. *Corolla* green externally, of a saffron yellow within. *Seed* round, unconnected.—We have taken the generic character, and the description, from Dombey's manuscript, compared with one of his original specimens. The fruit appears to be a *drupa*, (he terms it *barca*;) the size of hemp-seed, whose coat becomes coriaceous by drying, and separates, along with the permanent calyx at its summit, from the *seed*, or *nucleus*, to whose upper part the *corolla* remains attached. Jussieu, Lamarek, and Willdenow, having formed their ideas from dried specimens only, take the coat of the *drupa* for an inferior *calyx*, and the first of these writers conceives the flower to consist of a superior inner *calyx*, to which he was led by an idea of the affinity of this genus to *Thefium*. Willdenow, not adverting to any such affinity, terms the inner calyx of Jussieu, a *corolla*, which agrees with the opinion of Dombey, the only botanist who has examined the living plant, and by whose authority we are led to consider the true *calyx* as

superior. If we are right, this genus will belong to the natural order of *Rubiaceæ*, notwithstanding its solitary seed. Dombey expressly says it is akin to *Morinda*.

Feuillée relates, that the Indians take a decoction of this plant for internal disorders, especially when they believe themselves labouring under an internal abscess, of which there is no external appearance. The decoction, taken warm, is supposed to break the abscess, and to cause an evacuation of its contents by the usual passages.

QUINCUNX, *Quinque uncia*, denotes a thing that consists of five twelfth parts of another.

QUINCUNX, in *Gardening*, is the name of a form of planting in which trees are planted by fives, four of them form-

ing a square, and the fifth placed in the middle, thus,

and which may be repeated over and over again in one continued plantation, with as many trees in several ranges as may be proper. It was formerly a fashionable mode of planting groves and other regular plantations, but is now less common. It is seen more fully below:



Something of this mode of arrangement has always a good effect in the disposition of shrubby plants, &c. though not in the regular order of it, but something nearly so, which gives the shrubs a greater scope of growth, and shews them to greater advantage. It is likewise a mode of planting that is proper in the kitchen-garden, in transplanting many kinds of esculent plants; such as lettuces, endive, strawberries, and even all the cabbage kinds, and many other plants, which gives them a greater scope to grow than if planted exactly square at the same distance from each other.

It is of this kind of quincunx that Cicero speaks, in his *Cato Major*; and Quintilian, lib. viii. cap. 3.

The modern quincunxes, Daviler observes, are made like those of the ancients, except for the fifth tree, which is now generally disused; so that, being as it were netted, and their alleys viewed by the side of the rectangle, they formed a perfect chequer.

QUINCUNX, in *Astronomy*, &c. denotes a position, or aspect of the planets when distant from each other a hundred and fifty degrees, or five signs.

QUINCY, in *Geography*, a town of France, in the department of the Seine and Marne; six miles S.W. of Meaux.

QUINCY, a post-town of America, in Norfolk county, Massachusetts, taken from Braintree; 10 miles S. of Boston. It contains 1281 inhabitants, most of whom are farmers; but large quantities of shoes and boots are manufactured for exportation. The town has an episcopal and congregational church.

QUINDECAGON, in *Geometry*, a plain figure which has fifteen sides and fifteen angles.

The word is formed somewhat irregularly, from the Latin *quinque*, five, and the Greek *δεκα*, ten, and *γωνια*, angle. *Pentecagon* would be a more regular term.

If the sides be all equal, it is a regular quindecagon.

Euclid shews how to inscribe it in a circle, Prop. xvi. lib. 4. And the side of a regular quindecagon so described, is equal in power to the half-difference between the side of the equilateral triangle, and side of the pentagon; and also to the difference of the perpendiculars let fall on both sides, taken together.

QUINDECIM VIR, XV. VIR. a Roman magistrate, who

who had fourteen colleagues joined with him in the same function.

Under Tarquin the Proud, there were first two magistrates erected to take care of the sacrifices to be performed; these were called *duumviri*. Their number, at length, grew to ten, and then they were called *decemviri*. In the time of Cicero it had reached to fifteen, when they assumed the name of *quindecimviri*: and though their number grew to forty afterward, yet Servius observes, on the sixth of the *Æneid*, that their name never after changed, but they still continued to be called *quindecimviri*.

They were the persons who examined the Sibyls' books, and were the interpreters of them; yet they never did this but by express order of the senate, declared by a *senatus consultum*. They also presided at the sacrifices, and all other extraordinary ceremonies of religion.

On medals, a dolphin joined with a tripod marks the priesthood of the *quindecimviri*; who, to publish their solemn sacrifices, used on the eve of them to carry a dolphin at the end of a pole throughout the city; that fish being esteemed sacred to Apollo, as the crow was among birds.

QUINEPAUGE, or *East River*, in *Geography*, a river of America, in Connecticut, which runs a southerly course into the N.E. corner of New Haven harbour.

QUINGEY, a town of France, in the department of the Doubs, and chief place of a canton, in the district of Besançon; nine miles S.W. of Besançon. The place contains 1079, and the canton 11,734 inhabitants, on a territory of 272½ kilometres, in 36 communes. N. lat. 46° 6'. E. long. 5° 57'.

QUINGOMBO, in *Botany*, the name given by the people of Congo to a species of ketmia, distinguished by M. Tournefort by the name of the ketmia *Brasilensis folio ficus, fructu pyramidato fulcato*, the fig-leaved Brazilian ketmia, with a pyramidal fulcated fruit.

QUINISDAL, in *Geography*, a town of Norway, in the province of Christianland; 35 miles W.N.W. of Christianland.

QUINI-SEXTUM, in *Ecclesiastical History*, denotes a council held at Constantinople in the year 692; called also the council in Trullo, and by the Greeks *Pentheôte, q. d. five-sixth*; as intimating that it was only a supplement of the two preceding councils. Though, in propriety, Fleury observes, it was a council itself.

Marshall observes, that the fifth and sixth general councils having made no canons relating to the external celebration of divine worship, the government of the church, and the lives and manners of Christians, the Orientals judged it necessary to supply that defect by this; so that the 102 canons falsely attributed to those, were in reality made here. See **TRULLUM**.

QUINNET, in *Mining*, the name of a tool used in the cleaving rocks by means of gunpowder. This is a sort of wedge fitted to the flat side of what is called the *gun*; that is, a cylindric piece of iron, only flattened in one part to receive this, and drilled through. When a proper hole has been made in the rock by the borer, the powder is put in, and then the orifice being flopped by the gun, and that wedged in by this quinet, the powder being fired by a train communicating with the hole drilled through the guns, exerts all its force on the rock, and splits it in several directions at one explosion. Phil. Trans. N° 167.

QUINOLA, in *Geography*, a town of Mexico, in the province of Culiacan; 50 miles S.E. of Culiacan.

QUINQUAGENARIUS, among the Romans, was an

officer in the army, who had the command of a company of fifty men.

QUINQUAGENARIUS was also an officer of policy, who had the inspection of fifty houses, or families.

And in the ancient monasteries, *quinquagenarius* was a superior who had fifty monks under his guidance.

QUINQUAGESIMA-SUNDAY, *SIMONE-SUNDAY*. It is thus called, as being about the fiftieth day before Easter. Anciently they used *Quinquagesima* for *Whitsunday*, and for the fifty days between Easter and *Whitsunday*; but to distinguish this *Quinquagesima* from that before Easter, it was called the *Paschal Quinquagesima*.

QUINQUANGULAR LEAF. See **LEAF**.

QUINQUANNION, **QUINQUENNium**, in the *French Customs*, a respite of five years, which insolvent debtors formerly obtained by virtue of the king's letters, to have time for the payment of their debts.

When the thing intended was only to prevent the sale of their effects at an under-value, the term of one year was ordinarily granted, and this was called the benefit of *annion*.

But when the debtor would avoid the surrendering of his effects, upon proving that he was reduced by poverty, losses, &c. to make use of this expedient, the term of five years was granted, and called the benefit of *quinquannion*.

QUINQUATRIA, in *Antiquity*, a name given to the feasts of Minerva, otherwise called *Panathenæa*.

Some think they were termed *quinquatria*, because they lasted five days; but others, with more reason, think it was because they fell out five days after the ides of the month.

QUINQUE PORTUS, the five cinque ports.

"*Servitium quod barones quinque portuum præscriptorum recognoscunt facere ad summationem regis per annum, si contigerit per 15 dies ad cultum eorum proprium; ita quod primus dies computatur a die quo vela navium erexerunt, usque partes ad quas tendere debent, vel ulterius, quamdiu rex voluerit ad cultum ejus.*" Thorn.

QUINQUEFOLIUM, in *Botany*, *Cinquefoil*, the old name of the Linnæan genus *Potentilla*, many, but by no means a majority, of whose species have five leaflets on a stalk. Gartner, who, like many others, was discontented with *Potentilla*, substituted the word *Pentaphyllum*. See **POTENTILLA**.

QUINQUEMPOIX, in *Geography*, a town of France, in the department of the Lower Seine; seven miles N. of Rouen.

QUINQUENNALIA, in *Antiquity*, games, or feasts founded at Tyre, celebrated every five years, in honour of the deified emperors.

The *quinquennalia* began to be expressed on medals about the middle of the third century. F. Pagi produces a medal whereon are engraven those of the emperor Posthumus; they are not found on any medals of his predecessors.

QUINQUENNALIS, a magistrate in the colonies, and municipal cities of the Roman commonwealth; much the same with *ædile* at Rome.

They were not thus called from their continuing in their office five years; but because they were elected every fifth year, to preside at the census, and to receive the declaration each citizen made of his effects.

QUINQUENNES, in some old *Historians*, a name given to a certain people of India, among whom the women began to bear children at five years old, and seldom lived to more than eight years. Pliny gives us this account; and Solinus, who repeats it from him, increases the miracle by telling us, that

that they were a nation of women who had no men among them.

QUINQUEPARTITE LEAF, among *Botanists*. See **LEAF**.

QUINQUEPRIMI, among the Romans, the five principal men in the senate of every municipal town.

QUINQUEREMIS, in the *Naval Architecture of the Ancients*, a name given to a galley which had five rows of oars. They divided their vessels in general into monocrota and polycrota; the former had only one tier of rowers; the latter had several tiers of them, from two or three, up to twenty, thirty, or even forty; for such a vessel we have an account of in the time of Philopater, which required no less than four thousand men to row it. See **POLYCROTA**.

QUINQUERTIONES, among the Romans, an appellation given to those who had gained the victory in the *quingertium*, or *pentathlon*.

QUINQUERTIUM was the same with the Grecian pentathlon, comprehending the five exercises of running, leaping, throwing, darting, and wrestling. See **PENTATHLON**.

QUINQUE VIR, frequently wrote **V. VIR**, a Roman magistrate, who had four colleagues joined with him in the same function.

There were various kinds of officers thus denominated. Pomponius the lawyer mentions *quinqueviri* on this and on that side of the Tiber, established for the administration of justice in the night-time, in lieu of the ordinary magistrates, who were not judged proper to run up and down the streets in the dark.

Rofinus tells us, that they were sometimes the *quinqueviri* who conducted the colonies, and divided the lands assigned to them among the several families.

Sometimes the *epulones* were five in number; in which case they were called *quinqueviri*. See **EPULO**.

QUINQUEVIRI MONETarii, were officers first erected under the consulate of Valerius Poplicola, to moderate the excessive usury, or interest, which creditors or bankers used to exact from the people.

QUINQUINA. See **CORTEX Peruvianus**.

QUINSEY, sometimes written *Quinansley*, and *Quinzy*, in *Medicine*, a corruption of the French word *quinancie*, which again is derived from the Greek, *cynanche*, *κυνανχη*, signifying fore-throat, or inflammation and tumour of the internal fauces. The term is applied generally to inflammations of the throat, but more particularly to the acute inflammation of the tonsils. A tonsil, enlarged from inflammation, is also emphatically called a *quinsey*. See **CYNANCHE tonsillaris**.

QUINSEY, among domestic animals of the live-stock sort, is an affection about the throat and breast, which often attacks them, and which is very obstinate and troublesome. In horses it is usually called *anticor*.

QUINSIEME, or **QUINZIEME**, in our old *Law Books*. See **FIFTEENTH**.

QUINSIGAMOND, or *Long Pond*, in *Geography*, a lake of Massachusetts, between Worcester and Shrewsbury. This is a beautiful lake, in form of a crescent, about five miles long, and from 60 to 100 rods broad. It is intersected with a number of islets, one of which is upwards of 200 acres in extent.

QUINSON, a town of France, in the department of the Lower Alps; 25 miles S.S.W. of Digne.

QUINT, a sequence of five cards of the same colour. See **SEQUENCE**.

QUINTA, Ital. **QUINTE**, Fr. (See **FIFTH** and **DIAFENTE**.) The chord of the $\frac{5}{4}$ in thorough-bass is resolved two ways: first, by the bass rising one note, and the lowest

treble note descending; secondly, by the highest note of the chord rising, and the lowest remaining stationary, when the discord is resolved upwards. This is what Rameau calls *le double emploi de la dissonance*.

QUINTA Pars, in old madrigals, a 5th vocal part, composed of the refuse of the other four.

QUINTA Essentia. See **QUINTESSENCE**.

QUINTAIN, **QUINTANA**, in *Ancient Customs*, a post, or pillar, driven into the ground, with a buckler fixed to it, for the performance of military exercises on horseback, the throwing of darts, breaking of lances, &c.

Matth. Paris describes the quintain as a kind of mark, formed like a man from the navel upwards, holding a shield in his left hand, and in his right a sword or stick; the whole so fitted as to turn round on its foot, and so as that a cavalier running a-tilt against it with a lance, if he hit it in the breast, it whisked round, and, unless he were very dextrous, struck him with the sword held in the other hand.

In other places, at the top of a post, was erected a slender beam fitted to turn round a spindle; at one of whose ends was a slope or flat board, and at the other a bag of sand or dirt. The sport was, with a long staff, or wooden lance, to ride a-tilt at the board, and to be either so skilful or lucky to escape the blow of the sand-bag.

This some take to be the same with the *arietum levatio*, frequently prohibited in our old synods and episcopal constitutions.

The custom is still retained in Shropshire, and some other counties, among the nuptial solemnities. He that breaks the most poles against the quintain, has the prize; which was anciently a peacock, but is now a garland.

Some derive the word from an ancient game called *quintus*; others from a man of the name of Quintus.

The *vallus* and *palus*, mentioned in Cæsar, are taken, by Vigenere, for a kind of quintain, or wooden man, fixed up as an adversary, or man of straw, to prove one's dexterity against.

Mention is made of this exercise in the Code, *De Aleatoribus*, and in the Paratitles of Cujas on the same. Juvenal speaks of women engaging in it:

“ Aut quis non vidit vulnere pali? &c.”

QUINTAIN was also a right which the lord had to oblige all the millers, watermen, and other young people unmarried, to come before his castle every three years, and break several lances or poles against a post, or wooden man, for his diversion.

QUINTAL, in *Commerce*, the weight of a hundred pounds.

The quintal admits of some difference in different places, according as the pound consists of more or fewer ounces, and as the ounce is lighter or heavier.

Thus, *e. gr.* the Paris quintal, or hundred, in the old system, yields 123lbs. at Montpellier; and the Montpellier hundred only 81lbs. 9 oz. 18 gr. French poids de marc, or 88lbs. avoirdupois nearly. The quintal of Constantinople is esteemed the heaviest of all those used in the Levant: it contains 44 okes, or 100 rottoli; the oke being 4 ysf-dromes or cheques, or 400 drachms, and the rottolo 176 drachms. The quintal, or kintal, of cotton yarn is 45 okes. The quintal, or cantaro, weighs about 123½lbs. avoirdupois, and the oke 2lbs. 13 oz.; the rottolo, 19½ oz. and the cheque, 11½ oz. avoirdupois. The quintal is equal to 112½lbs. of Amsterdam; 124lbs. of Venice; and 160 of Leghorn. The quintal of Lisbon contains 4 arrobas, the arroba 32 pounds, the pound, libra, or arrate, 2 marks, or 16 ounces; the ounce, 8 outavas: 13½ quintals make a ton. The pound

pound of Lisbon weighs 9552 Dutch ascs, 7084 $\frac{3}{4}$ grains English troy weight; and therefore 83lbs. of Lisbon = 84lbs. avoirdupois weight.

The English quintal usually consists of 112lbs. avoirdupois, and is divided into four quarters.

QUINTAL was also formerly used for a weight of lead, iron, or other common metal, usually equal to a hundred pounds, at six score to the hundred.

QUINTE', *Isle de*, in *Geography*, an isle in lake Ontario, Upper Canada, which lies close off the shore of Ameliasburg, and opposite the W. point that forms Sandy bay.

QUINTE, in *French Music*, is the name of the instrumental tenor part in full pieces, usually written in the mezzo soprano clef on the second line. All the instrumental tenor or alto viola parts, in Purcell's time, were written in this clef, as may be seen in his overtures and aëttunes. This was an imitation of France, where all the tenor parts in Lulli and Rameau's operas are in the mezzo soprano clef.

QUINTELLO, Ital. QUINQUE, Fr. a vocal or instrumental composition in five parts, dialogued, and generally *a parte eguale*. The instrumental quintets of Boccherini and Mozart are sublime productions: there is, perhaps, no instrumental music in which more genius and abilities are manifest, than in the quintets of these great masters.

QUINTENAR, EL, in *Geography*, a town of Spain, in New Castile: 37 miles S. of Hueta.

QUINTER, QUINTOIER, Fr. in the first attempts at harmony, was counterpoint in a series of 5ths, any two of which, in aftertimes, would ruin for ever the reputation of a composer.

QUINTESSENCE, *quinta essentia*, in the old *Chemistry*, properly denoted the fifth essence, or the result of five successive distillations. The term, now obsolete, was used to express the highest degree of rectification to which any substance can be brought. It also signified a preparation consisting of the essential oil of some vegetable substance, mixed and incorporated with spirit of wine.

Thus, on a proper quantity, *e. gr.* of essential oil of fennel, pouring twelve times the quantity of pure alcohol prepared *per se*, they instantly unite into one similar liquor, which is the quintessence of that plant.

The ancients were perfectly unacquainted with the method of dissolving oil in spirit of wine; and even some of the moderns have questioned its reality: but the certainty of the thing is easily proved, from the instance above, and from a thousand others.

If such quintessence be several times digested, cohobated, &c. the oil will at length be broken so fine, as, like the spirit itself, perfectly to mix with water; which is one of the most extraordinary effects in all chemistry.

After the like manner is made a quintessence of camphor, by only pouring on it spirit of wine.

Quintessences, thus prepared, were supposed to have great medicinal virtues; on account of the pure and potent ingredients used in their composition; which retain, in a great degree, all the virtues of the plants they are procured from: and hence their denomination.

Boerhaave thinks, they might properly be called vegetable sulphurs made potable, and raised to their utmost degree of power and efficacy.

Dry quintessences may be made from the liquid ones, by adding to them some more essential oil of the same vegetable from whence the liquid quintessence was procured, with a little sugar, all mixed together, and distilled, by a very gentle heat, till all the moisture is come over; the matter remaining is then a dry quintessence.

This form was deemed principally useful for travellers, sailors, &c. inasmuch as it renders the quintessence portable; so that the quantity, *e. gr.* of a pin's point, shall be an efficacious medicine.

QUINTESSENCE, in *Alchemy*, is a mysterious term, signifying the fifth, or last and highest essence, or power, of a natural body.

This is supposed to be, as it were, the soul drawn from the gross body and its four elements, by a most perfect distillation; and, by means of which, the thing is said to be spiritualized, *i. e.* rendered exceedingly pure, spirituous, and, as it were, incorruptible.

The ancients, who allowed nothing to be real but what has a body, would have the soul of man to be a fifth element, a kind of quintessence without a name, unknown here below, indivisible, immoveable, all celestial, and divine. Fenelon.

QUINTESSENCE of the *Elements*, is the hermetical mercury.

QUINTESSENCE of *Wine*, a term used by Glauber to express an essential oil of wine, which he directs to be made by a careful distillation; and which he is very fond of, as having a power to meliorate, improve, and even to specify the poorer wines into the nature of those from which it was obtained.

This is one of the schemes of Glauber, generally esteemed an impracticable one, though very plausible in theory: but though in general there is a disagreeable flavour in the quintessence drawn after his method, which is different from the true flavour of the wine, and spoils the liquor it is added to; yet, by proper care, there is a possibility of succeeding so far as to render this extraneous flavour almost imperceptible, and produce an oil that will mend poor wines extremely, and give a truly vinous flavour to such as are in themselves tasteless. But whatever may be done by this method, may also be done with much more certainty, and much less trouble, by the concentration of wines by freezing. This may be easily practised in the wine countries; and by this means Burgundy, Champagne, and other the most valuable wines, may be reduced into thick extracts and robs, by the means of which wines may be made in England; a very small quantity of these concentrated wines being sufficient to convert the whole of any of the poor tasteless and insipid wines, which are of themselves of little or no value, into the very wine from which the rob was made; and that in such perfection, that the nicest judge cannot find out the difference.

These robs of wine, made and preserved upon the spot, would also be of infinite use in the wine countries, as they might be kept to improve the wines of bad years. Stahl, De Concentr. Vin. Shaw's Chem. Ess.

QUINT-EXACT, in old *Law Books*, the last call of the defendant sued to an outlawry. If he appear not to it, he is, by the judgment of the coroners, returned outlawed, if a feme, waived.

QUINTI, *Bay of*, in *Geography*, a bay and harbour in the N.E. part of lake Ontario, at the mouth of the Trent; formed by a large peninsula, consisting of the townships of Ameliasburg, Sophiasburg, and Marysburg, extending easterly from an isthmus, where is a portage at the head, or W. end of the bay, to Point Pleasant, the eastermost extremity of the peninsula, opposite to Amherst island. The river Trent discharges itself into the head of the bay, westward of the portage, and supplies it with the waters of the Rice lake. Westward of the portage in lake Ontario, is the harbour of Presque Isle de Quinté, now called Newcastle. The fertility of the soil about the bay of Quinté is generally allowed. The land is rich and easily wrought, and produces several crops without manure; 25 bushels of wheat being often

often produced from an acre. The timber, like that of the other parts of the province, consists of oak, elm, hickory, maple, &c. The bay is narrow throughout, and about 50 miles long, through which distance it is navigable for the small vessels that are used on the lakes. It abounds with wild fowl, and various kinds of fish. The river Trent affords a salmon fishery. In passing from the head of the bay of Quinté into lake Ontario, you cross a short portage, in front of the township of Murray, being the isthmus between it and the peninsula of Prince Edward. At the end of the portage, and before you enter lake Ontario, is a small but very beautiful lake, having very good land on its banks. To the northward of this portage it has been proposed to make a canal for connecting the waters of the bay with those of the lake. A little to the westward of the portage and proposed canal, is the harbour of Newcastle, a situation well suited for commerce and protection, and sheltered from all winds. A knoll on the peninsula affords a healthy site for the town.

QUINTILE, QUINTILIS, in *Astronomy*, an aspect of the planets, when they are seventy-two degrees distant from one another, or a fifth part of the zodiac.

QUINTILIAN, MARCUS FABIVS, in *Biography*, a celebrated teacher of eloquence, was born about the year 42 of the Christian era, during the reign of the emperor Claudius. He is supposed to have descended from a family originally Spanish, but that his father, or grandfather, had settled in Rome. The place of his birth is not known, but it seems certain that he was educated in that capital, where he studied rhetoric under Domitius Afer, a celebrated orator. He opened a school at Rome, and was the first who obtained a salary from the state as a public teacher. After he had remained twenty years in this laborious employment, and obtained the applause of the most illustrious Romans, not merely as a preceptor, but as a pleader at the bar, Quintilian retired to enjoy the fruits of his labours and industry. In his retirement he assiduously devoted his time to the study of literature, and wrote a treatise on the "Causes of the Corruption of Eloquence." Some time after, he wrote his "Institutiones Oratoriae," the most perfect and complete system of oratory extant. It is, in truth, one of the most valuable remains of antiquity. It was composed for the use of his son, whose early death he had occasion to deplore, and is an institute for the education of an orator, whom he takes up from the cradle, and conducts through all the periods of instruction to the exercise of his proper art. It accordingly contains many excellent precepts with respect to education in general, especially the early parts of it, which are applicable in all times and countries, as being founded on the nature of the mind. The style of Quintilian is said, by critics, to exhibit tokens of the deterioration of the Latin tongue; but, on the other hand, it must be observed, that every deviation from the usage of the Augustan age has been too readily regarded as a depravation. Quintilian was appointed preceptor to the two young princes whom Domitian destined for his successors on the throne; but the celebrity which the rhetorician received from the favours and attention of the emperor, and from the success which his writings met with in the world, were embittered by the loss of his wife, and of his two sons, one of whom he describes as a prodigy of early excellence. It is said that Quintilian was poor in his retirement, and that his indigence was relieved by the liberality of his pupil, Pliny the younger. He is supposed to have died about the year 95. His "Institutiones" were discovered in the year 1415, in an old tower of a monastery at St. Gall, by Poggio Bracchiolini. The treatise on the "Causes and Corruption

of Eloquence" has not come down to us. The name of Quintilian is affixed to certain "Declamations," of which there are 19 of moderate length; but as the style, method, and manner, are totally different from the rules laid down in the "Institutiones," no good judges attribute them to the name of Quintilian. Of the editions of Quintilian some of the most valuable are those of Gesner, 4to. Gotting. 1738; of Lug. Batavorum, 8vo. cum notis variorum, 1665; of Gibson, 4to. Oxon. 1693; and that of Rollin, re-published in London in 1792. There is an English translation by Mr. Guthrie.

QUINTILIANS, QUINTILIANI, in *Ecclesiastical History*, a sect of ancient heretics, the same with the Pepuzians; thus called from their prophets Quintilia.

In this sect, the women were admitted to perform the sacerdotal and episcopal functions; grounding their practice on that passage of St. Paul to the Galatians, where he says, "That in Christ there is no distinction of males and females."

In their assemblies, it was usual to see the virgins enter in white robes, personating the prophetesses. The Quintilians bore some resemblance to the modern Quakers.

QUINTILIS, in *Chronology*. See JULY.

QUINTIN, or QUINT, in *Commerce*. See QUENTIN.

QUINTIN, in *Geography*, a town of France, in the department of the Northern Coasts, and chief place of a canton, in the district of St. Brieuc; nine miles S.W. of St. Brieuc. The place contains 3976, and the canton 12,510 inhabitants, on a territory of 147½ kilometres, in eight communes.

QUINTINIE, JOHN DE LA, in *Biography*, famous for his skill in horticulture, was born at Poitiers in 1626. He received a learned education, and was brought up to the profession of the law, in which he gained reputation as a pleader at the bar. A passion for agricultural knowledge led him to study, with great attention, all the authors, ancient and modern, upon that topic; and on a visit to Italy as tutor to a youth, he made great additions to his knowledge from actual observation. On his return he devoted himself almost entirely to experiments on the culture of trees and plants, and made many discoveries which greatly improved the art of gardening. He was the first person who laid down just principles of the art of pruning fruit-trees. He also remarked that a transplanted tree grew only by the new roots which it threw out, and that the old fibres were useless, and ought to be cut off. It does not appear at what time he began to follow gardening as a profession, but he had certainly acquired a high degree of reputation in it when he was invited to England by Charles II. who offered him a considerable pension to engage him in his service. He twice visited London, and a paper of his was published in the Philosophical Transactions, on the culture of melons. He was made, by Lewis XIV., director-general of the gardens in all the royal palaces. In 1690 he published "Instructions pour les Jardins Fruitiers et Potagers," which obtained a high degree of popularity, was frequently re-printed, and was translated into several modern languages. The last edition was entitled "Parfait Jardinier," in two vols. 4to. The author died at Paris in the year 1700.

QUINTO, in *Geography*, a town of Spain, in Arragon; 20 miles S.E. of Saragossa.

QUINTUS CALABER, in *Biography*, a Greek poet, who wrote a supplement to Homer's Iliad, in 14 books, in which a relation is given of the Trojan war from the death of Hector to the destruction of Troy. He is supposed, from the style of his work, to have lived in the fifth century, but nothing certain can be collected concerning his person and country. His poem was first made known by

cardinal Bessarion, who discovered it in St. Nicholas' church, near Otranto in Calabria; hence the author was named *Quintus Calaber*. It was published at Venice by Aldus, but there is no date attached to the title page.

QUINTUS CURTIUS. See **CURTIUS**.

QUINTUS Femoris, in *Anatomy*, a name given by Fallopius and many others to one of the muscles of the thigh, now called the psoas magnus.

QUINTUS Oculorum, a name given by Vesalius and some others to one of the muscles of the eyes, more expressly called by others obliquus superior oculi, and opifex circumgyrationis oculi.

QUINVA, in *Botany*, a name by which some authors have called the amaranth, or cockscomb.

QUINZANO, in *Geography*, a town of Italy; 18 miles S.W. of Brescia.

QUINZIEME, Fr. in *Music*, the double octave, above or below any sound (see **FIFTEENTH**); which is the name of a stop in our organs, equidistant from the diapason.

QUIOPELA, in *Zoology*. See **VIVERRA Mungo**.

QUIPOS, in *Literary History*, a name given to knots on cords of different colours, in Peru, which imperfectly supplied the place of writing. This device was adopted, as it has been said, for rendering calculation more expeditious and accurate. The various colours denoted different objects, and each knot expressed a distinct number. Thus an account was taken, and a kind of register kept of the inhabitants in each province, or of the several productions collected there for public use. But as by these knots, however varied or combined, no moral or abstract idea, no operation or quality of the mind could be represented, they contributed little towards preserving the memory of ancient events and institutions. The Mexican paintings and symbols, rude as they were, conveyed more knowledge of remote transactions than the Peruvians could derive from their boasted quipos. If, indeed, the latter had been of more extensive use, and better adapted to supply the place of written records, they perished so generally, together with other monuments of Peruvian ingenuity, in the wreck occasioned by the Spanish conquest, and the civil wars subsequent to it, that no accession of light or knowledge is derived from them. Robertson's *Hist. Amer.*, vol. iii.

QUIQU, in *Zoology*, a species of *Muscula*; which see.

QUIRAZAI, or **CURAPOA**, in *Ornithology*. See **CRAX Alestor**.

QUIRE of Paper, of the French *cabier*, the quantity of twenty-four or twenty-five sheets.

QUIRICIA, a name given by some to the stone called *quiris* by the generality of writers.

QUIRICU, in *Geography*, a town of France, in the department of the Iſere; 12 miles E. of Ballay.

QUIRINACIUM OPIUM, in the *Materia Medica*, a name given by some to the gum we know by the name of *assa fetida*.

QUIRINALIA, in *Antiquity*, feasts celebrated, among the Romans, in honour of Romulus, who was called Quirinus. See **QUIRITES**.

The Quirinalia, called also *ſtultorum feria*, were held on the 13th of the calends of March, i. e. on our 17th of February.

QUIRINI, ANGIOLO-MARIA, in *Biography*, a learned cardinal, by descent a Venetian, was born in the year 1680. While young he entered into the order of the Benedictines of Monte Cassino. At Florence he pursued a very extensive course of study under several of the most eminent men in science and literature of that age.

Upon his entering a professorship in his convent, he delivered an oration "*D. Mollicæ Historiæ Prestantia*," which was printed. His studies were interrupted some time, by an imagination that he was afflicted with a stone in his bladder; but the death of his physician, who fell a victim to a false impression respecting his own case, freed him from his fancied complaint, and in the year 1710 he set out upon his literary travels. He visited Germany, Holland, England, and France, making in the latter country an abode of more than two years, during the greatest part of which time he resided in the Benedictine abbey of St. Germain des Pres. In the course of his travels he formed an acquaintance with almost all the literary characters in those countries, and visited every object of learned curiosity, at the same time every where exciting a general esteem of his talents, his industry, and his conduct. Upon his return to Italy he published a Dissertation containing a Plan for a History of Italy;—an Essay on the History of Farfa, in the Duchy of Spoleto;—and an edition of the Office for Divine Service according to the Usage of the ancient Greek Church. He was soon after created bishop of Corfu, by pope Innocent XIII., a dignity which he filled in such a manner as to inspire the Greek separatists with veneration for his person. His residence in Corfu was the cause of his composing a learned work, entitled "*Primordia Corcyræ ex antiquissimis Monumentis illustrata*," 4to. 1725. In the year 1727, Benedict XIII. raised Quirini to the cardinalate, after having nominated him to the bishopric of Brescia. His promotion to that see was followed by some publications relative to the literature of Brescia. His attachment to the see of Rome was displayed by a life of pope Paul II. printed in 1740, the object of which was to defend the memory of that pontiff against the attacks of Platina. Soon after this he was appointed librarian to the Vatican; in this and other posts he continued to serve the cause of literature. It was through his means that a new edition of the works of St. Ephrem was given in 6 vols. fol. in the Greek, Syriac, and Latin languages. He likewise edited the letters of cardinal Pole, written against the principles of the reformers. This prelate died, greatly regretted, at his episcopal residence, in 1755, at the age of 75. Though a vigorous champion of the papacy, he wrote with a spirit of candour and moderation, which obtained the applause of the Protestants themselves. He was associated to several literary societies, among which were the academies of Petersburg, Berlin, and Vienna, and the Institute of Bologna. He enjoyed a large revenue, which he expended with munificence, on objects of charity and public splendour. At Rome he beautified the church of St. Mark, whence he derived his cardinal's title, and he contributed liberally to the fine Catholic church at Berlin. He laid the foundation, by a valuable gift of books, of a public library at Brescia. His own select and valuable library he presented to the Vatican. His charities were numerous and extensive, and he was indefatigable in performing his pastoral duties, visiting the alpine parts of his diocese in the most inclement seasons. Besides the works already mentioned, he published an account of his own life, and a narrative of his travels.

QUIRIQUING, in *Geography*, an island on the coast of Chili, near the entrance into the bay of Concepcion. S. lat. 36° 35'.

QUIRIS, *Quirinus lapis*, a name given, by the writers of the middle ages, to a stone famous among them for its imaginary virtues, but of which they have left us no description.

QUIRISTER, **CHORISTER**, or *Chorista*, a person appointed

pointed to sing in the quire, or choir, of a cathedral. See ANTHEM, CHANTOR, and CHOIR.

QUIRITES, in *Antiquity*, an appellation given to the people of Rome, chiefly the common citizens, as distinguished from the soldiery.

It took its rise from the Curetes, the inhabitants of the Sabine town Cures. On this occasion Romulus, and Tatius king of the Sabines, having united their two people, and their two states, into one; upon Romulus's death and deification, the Sabines, outdoing the Romans in number, became masters of the councils; and accordingly appointed, that Romulus should be denominated Quirinus, from Cures, a city of the Sabines; or rather from Quirinus, the name of a god worshipped in that city.

From the new Quirinus, all the people came afterwards to be called Quirites; unless we will suppose, that the same authority which denominated Romulus Quirinus, from Cures, did also denominate the people Quirites, immediately from the Curetes.

Some authors derive the word Quirinus from Curis; which, in the Sabine tongue, signified a pike, or halbert. Struvius adds, that Romulus was always painted with a pike in his hand.

Julius Cæsar, as Tacitus informs us, (*Annal.* i. 43.) appeared a sedition by the use of this word *Quirites*, which opposed to *soldiers*, expressed contempt, and reduced the offenders to the less honourable condition of mere citizens. The emperor Alexander also applied it to the same purpose. See his biographical article.

QUIRK, in *Building*, a piece of ground taken out of any regular ground-plot, or floor.

Thus, if the ground-plot were square, or oblong, and a piece be taken out of a corner, to make a court, or yard, &c. the piece is called a quirk.

QUIROGA, in *Geography*, a town of Spain, in Galicia; 24 miles N.E. of Orense.

QUIROS, CAPE, lies on the E. coast of the island of Espiritu Santo, in the South Pacific ocean. S. lat. 14° 56' 8". E. long. 167° 20'.

QUIRPELE, in *Zoology*, the name of a small animal, called by some authors the *Indian ferret*, or *viverra Indica*, and by others *quill*. See VIVERRA *Mungo*.

Garcias and some authors give very remarkable accounts of the enmity this creature has to serpents of all kinds. They tell us, that when this little creature intends an attack upon one of these animals, it first prepares against danger, by gnawing a quantity of the root of the lignum colubrinum, or snake wood; and when it has thoroughly impregnated its saliva, it wets with it first its fore-feet, and with them daubs over its head and its whole body; and that thus prepared, it boldly attacks the snake, and never leaves off till it has killed it. Garcias assures us, that many of the Portuguese have been eye-witnesses of these combats.

It is probable enough, that this creature may attack a snake when thoroughly hungry, knowing its flesh to be good food; but the story of the antidote is to be suspected. See ICHNEUMON.

QUIRPEN, in *Geography*, an island in the North Atlantic ocean, near the N. coast of Newfoundland. N. lat. 51° 40'. E. long. 52° 22'.

QUIRSWYCK, a town of Norway; 60 miles N.N.E. of Romdøl.

QUIS, in *Natural History*, a kind of marcasite of iron or copper, from which vitriol is drawn. It is more frequently called pyrites.

QUISBRO, in *Geography*, a town of Sweden, in Nericia; 12 miles S.W. of Örebro.

QUISCALA, in *Ornithology*, a species of *Gracula*; which see.

QUISIBI, in *Geography*, a town of Arabia, in the province of Oman; 180 miles W. of Julfar.

QUISIL AUREN, a town of Asiatic Turkey, in Carmania; 15 miles W. of Cogni.

QUISONGALA ISLANDS, a cluster of small islands in the Indian sea, near the coast of Africa. S. lat. 10° 40'.

QUISPICHANCHI, a jurisdiction in the diocese of Cusco in Peru, beginning at the south gates of Quito, and stretching from E. to W. about 20 leagues. The lands of this jurisdiction belong, in general, to the richer inhabitants of Cusco, and produce plenty of wheat, maize, and fruits. Here are also manufactures of baize and coarse woollen stuffs. Part of the jurisdiction borders on the forests inhabited by wild Indians, and produces great quantities of coca, or cacao, an herb greatly used by the Indians working in the mines, and forming one of the principal branches of its commerce; the town lies 12 miles S. of Cusco.

QUISQUALIS, in *Botany*, a name combined by Rumphius of *quis*, who, and *qualis*, what kind or manner, by which he intended to express the singular variableness of the plant, as if nothing could be found like it.—*Linn. Gen.* 215. *Schreb.* 292. *Willd. Sp. Pl.* v. 2. 579. *Mart. Mill. Dict.* v. 4. *Juss.* 78. *Lamarck Illustr.* t. 357. —Class and order, *Decandria Monogynia*. Nat. Ord. *Verprecula*, Linn. *Thymelææ*, Juss.

Gen. Ch. Cal. Perianth inferior, tubular, thread-shaped, very long, deciduous, its border in five spreading segments. Cor. Petals five, inserted into the mouth of the tube, sessile, oblong, obtuse, spreading, much larger than the segments of the calyx. Stam. Filaments ten, bristle-shaped, inserted into the tube of the calyx, five of them below the rest; anthers oblong, in or above the mouth of the tube. Pist. Germen superior, ovate; style thread-shaped, longer than the stamens; stigma obtuse, dilated. Peric. Drupa dry, with five unequal angles. Seed. Nut elliptic-oblong, pentagonal.

Eff. Ch. Calyx with a thread-shaped tube; five-cleft. Petals five. Drupa superior, with five angles.

1. *Q. indica*. Linn. *Sp. Pl.* 556. (*Quisqualis*; Rumph. *Amb.* v. 5. 71. t. 38. *Q. pubescens*; Burm. *Ind.* 104. t. 35. f. 2. and *Q. glabra*; t. 28. f. 2.)—Native of Java, and the Molucca isles; naturalized by Rumphius in Amboyna. The stem is shrubby, at first low and stumpy, but subsequently throwing out long trailing or twining shoots, which become as thick as a man's arm. To this diversity of habit, and the changeable hue of the flowers, the name alludes. The young branches are clothed with fine soft down. Leaves opposite, occasionally scattered, on shortish downy stalks, ovate, pointed, entire, two or three inches long; their ultimate veins finely reticulated; both surfaces more or less downy, rarely smooth. Flowers in axillary or terminal bracteated spikes. Bractæas ovate, downy. Corolla two inches long, downy, whitish in the morning, turning pale red in the afternoon, rose-coloured in the evening, and the next morning of a blood red. Fruit as big as one joint of the finger. Nut eatable when quite ripe, having the flavour of a filbert. When unripe, Rumphius compares its taste to that of a radish. These nuts are a popular remedy, among the Malays, for worms in children. Two or three of the pungent unripe ones, or five of those that are arrived at maturity, are a dose. Some persons are attacked with a dangerous hiccup from eating two or three of the nuts in question, whilst others find no such effect from a considerable number. The integuments are carefully removed. They probably partake of the

poisonous qualities of the Mezereon tribe; though in a mild degree, as Rumphius speaks of the flavour of several parts of the plant, without mention of any very hurtful properties. Even the kernels of our European *Daphnes* are highly acrimonious.

QUISQUISANA, in *Geography*, a town of Peru, in the diocese of Cusco; 32 miles S.S.E. of Cusco.

QUISSAC, a town of France, in the department of the Gard, and chief place of a canton, in the district of Le Vigan, having a mineral spring; 20 miles N. of Montpellier. The place contains 1310, and the canton 3884 inhabitants, on a territory of 160 kilometres, in 12 communes.

QUISTELLO, a town of Italy, in the department of the Mincio; 15 miles S.S.E. of Mantua.

QUISTORP, JOHN, in *Biography*, a German Lutheran divine and professor, was born at Rostock in the year 1584. He pursued his academical studies at his native city, at Berlin, and at Franckfort on the Oder; and afterwards travelled through Holland, Brabant, and Flanders, in the capacity of governor to the son of a patrician of Lubec. In 1614, his learning and abilities pointed him out as a fit person to fill the divinity chair at Rostock; but before he entered upon the duties of his office, he was created doctor of divinity. He obtained other preferments in the church, particularly the archdeaconry of St. Mary's at Rostock. In 1645 he was appointed pastor of the same church, and superintendant of the churches in the district of that city. He had the felicity of rendering important services to the celebrated Hugo Grotius, during his last fatal illness at Rostock. Upon the death of that great man, he wrote a Latin letter to Calovius, containing an account of his sickness and last sentiments, which is inserted in the "Bibliothèque Choisie" of Colomies; and in the "Vindiciæ Grotianæ," under the title of "Grotii Manes." Quistorp died in 1648, at the age of 64. He was the author of "Annotationes in omnes Libros Biblicos," "Commentarius in Epistolam Sancti Pauli," and several other works. He left a son of the same name, who was born at Rostock in 1624, and died in 1669. He became pastor, professor of divinity, and rector of the university in that city.

QUISTRUM, in *Geography*, a town of Sweden, in the province of West Gothland; 9 miles N.W. of Uddevalla.

QUITANGONE, a river of Africa, which runs into the Indian sea, 15 miles N. of Mozambique, S. lat. 14° 40'.

QUITAPABILLA, a river of America, being a branch of the Swetara, which falls into the Susquehannah at Middleton.

QUITAPORA, a town of the state of Georgia. N. lat. 33° 27'. W. long. 89° 58'.

QUITCH, in *Agriculture*, a name frequently applied, in many districts, to a very troublesome set of plants of the weed kind; for though it properly belongs to the couch-grass plant only, it is much used to signify others of the creeping perennial rooted sort, as the bent, creeping, soft, and tall oat-grass, as well as some others, which are only capable of being destroyed by repeated summer ploughings, or forking them out and burning them on the ground. See **COUCH**.

QUITCH-Grass, the common name given in some places to a very troublesome sort of weed, found in many districts, and which requires great exertion to eradicate it out of the land. See **COUCH**.

QUITCH-Drage, that sort of useful tool of the drag-kind, which is employed in the dragging out and removing this sort of weed from ploughed lands. It is made in several different methods, according to circumstances; but has

mostly something of the long triangular form in the beam part, into which the teeth or tines are fixed. These are seldom made so large in this as in the heavy sorts of drags; but they are mostly a little hooked, or bent forward, towards the points or lower ends. The frame-part is sometimes set with two rows of tines, or more.

It is a sort of tool which is frequently made use of for rendering arable ground perfectly clear of root weeds, being had recourse to before the last ploughings. Where the land has been cross-ploughed, this kind of drag may be employed with great advantage in bringing it into proper order. It has some other names in different counties. See **COUCH-Drage**, and **DRAG**.

QUITCH-Rake, a name given in many districts to the rake employed in collecting the weed called couch, from the surface of ploughed ground, as well as some other sorts in particular cases. The head of this tool, into which the teeth or tines are fastened, is usually about five feet in length; the tines are made in a round form, having a projection of about eighteen inches below the head, each being gradually turned or crooked forward about two inches; the distance from each other also about two inches. There is commonly a small beam made to fasten in the middle with two pieces of wood, which come from each corner of the rake-head, into which the tines are fastened by means of a pin that goes through the beam, and keeps the rake steady. In working, this implement may be put on the carriage-part of a two-wheeled plough, to be drawn by one horse; a man going behind to occasionally lift up the rake when full, in order to leave the couch and other weeds in rows, for the purpose of burning them. In this manner, a great deal of weeds and trumphy may be collected together in the course of a day. See **COUCH-grass Rake**.

QUIT-CLAIM, a release, or quitting one's claim or pretensions to a thing.

QUITERVA, in *Geography*. See **SOFALA**.

QUITEVA, or **KITEA**, a town of Africa, in the country of Darah, defended by a castle; 75 miles S.E. of Morocco. N. lat. 28° 6'. W. long. 5° 26'.

QUITO, an extensive province of South America, which was subjected to the Peruvian empire, by Huana Capac, about the year 1526, at the time when the Spaniards first visited the coast of Peru. Huana prevailed on his legitimate and eldest son Huascar to allow one of his natural children, Atahualpa, by the daughter of the last king of Quito, to hold this kingdom as a fief of the empire. Atahualpa, however, rebelled, seized the empire, imprisoned his brother, and soon after put him to a violent death. His prosperity was of short duration; for in the year 1533 he suffered the same fate, by order of Don Francisco Pizarro, who had deputed Sebastian de Benalcazar to conquer the kingdom of Quito. Having by a series of victories made himself master of the kingdom, he proceeded in the year 1534 to rebuild the capital, which had suffered much from internal commotions, and called it "San Francisco de Quito," a name which it still retains, though it was not till seven years after this date that it obtained the title of city. The province, which the Spaniards found annexed to the kingdom of Peru, continued in that state till the year 1718, when it was dismembered from Peru, and attached to the viceroyalty of New Granada. At the same time the audience of Quito was suppressed, together with that of Panama, in the kingdom of Terra Firma: though the latter continued dependent on the viceroys of Lima. See **NEW GRANADA** and **PERU**.

This province is bounded on the north by that of Santa Fé de Bogota, and includes part of the government of Poyayan; on the south it is limited by the governments of Peru

Peru and Chacaboyas; towards the east it extends over the whole government of Maynas, and the river of the Amazons, to the meridian of demarcation, or that which divides the dominions of Spain and Portugal. Its boundary on the west is the sea, from the coast of Machala, in the gulf of Puna, to the coast of the government of Atacames, and the jurisdiction of Barbacoas, in the bay of Gorgona. Its greatest breadth from north to south is about 200 leagues; and its length from east to west, the whole extent from Cape de Santa Elena, in the South sea, to the above-mentioned meridian, which, by the most accurate computation, is 600 leagues. All the parts, however, that can properly be said to be peopled, and actually subject to the Spanish government, are those intercepted by the two Cordilleras of the Andes, which, compared with the whole extent of the country, may be termed a street or lane, extending from the jurisdiction of the town of St. Miguel de Ibarra to that of Loja; the country from hence to the government of Popayan, and also that comprehended between the western Cordillera and the sea. With this limitation, the extent of the jurisdiction from east to west will be 15 leagues, or somewhat more, being the distance intercepted between the two Cordilleras. But to this must be added the countries comprehended in the governments of Jaen de Bracamoros, which borders on the jurisdiction of Loja, and the extremity of the whole province, and situated on the east side of the eastern Cordillera; and to the northward, the government of Quixos, and that of Maynas to the eastward of it, but separated by large tracts of land inhabited by wild Indians; and on the north side of the province from that of Popayan; though the latter is properly a distinct province from that of Quito. Thus on the west side of that interval between the two Cordilleras lies the government of Atacames, and the jurisdiction of Guayaquil; on the east side, the three governments above mentioned; and on the north, that of Popayan.

This province, exclusive of these five governments, consists of nine jurisdictions, called in that country provinces, that of Quito being subdivided into as many others as there are governments and jurisdictions. Those in the province of Quito, beginning with the most northern, are the following, viz. the town of San Miguel de Ibarra, the village of Otobalo, the city of Quito, the asiento of Latacunga, the town of Riobamba, the asiento of Chimbo, or Gaaranda, the city of Guayaquil, the city of Cuenca, and the city of Loja.

The jurisdiction of Quito, the third of those above enumerated, consists of 25 parishes, besides those in the city, and extends more than five leagues, comprehending lands covered with plantations, producing a variety of plants and fruits, according to the quality, situation, and exposure of the ground. Those in the temperate parts yield plentiful harvests of maize; and those at the bottoms of deep cavities, being in a hot temperature, are planted with sugar-canes, from which are extracted great quantities of sugar and rum. The plantations near the summits of the mountains, having a variety of temperatures, produce wheat, barley, pot-herbs of all kinds, and potatoes. Above these plantations are fed numerous flocks of sheep, producing that wool which affords employment to a great multitude of people. Some farmers breed cows, with the view to the advantage derived from their milk in making cheese and butter. In other farm-houses, various occupations are observed, such as breeding of cattle, agriculture, and manufactures, particularly of cloth, bays, and ferges. The degree of cold and heat in this jurisdiction is subject to sudden variations, according to the situation of different places; but in the

same place vicissitudes seldom occur. The villages in this jurisdiction are constructed with little regularity. They consist principally of a church and parsonage, called the convent, the priests being formerly all religious; the other parts present a number of huts with mud-walls, scattered all over the country, where every one has his appropriate piece of ground, which he tills for his subsistence. A great part, and in some villages the whole, of the inhabitants are Indians, who live there when out of place; though in some parts the inhabitants are Mellizos, and here and there a Spanish family; but these are extremely poor. Ulloa's Voyage, vol. i.

QUITO, the capital of the above described province, rebuilt in the year 1534, (see the preceding article,) and situated in the inland parts of the continent of South America, on the eastern skirts of the West Cordillera of the Andes; distant from the coast of the South sea about thirty-five leagues to the west. On the N.W. is the mountain and desert of *Pichinca* (which see), on the acclivity of which the city is built, and also among the breaches that are formed by the eminences of this mountain; so that many of the buildings stand upon arches, and the streets are of course very irregular and uneven. With regard to magnitude, this city may be compared to one of the second order in Europe; but the unevenness of its situation is a great disadvantage to its appearance. Near the city are two spacious plains, one on the S., called Turu-bamba, three leagues in length; and the other on the N., termed Inna-Quito, about two leagues in extent; both of which are interspersed with seats and cultivated lands, which much contribute to the variety and beauty of the scenery. These plains contract as they approach the city, and at their junction form a neck of land, covered with those eminences on which part of Quito stands. The principal square in Quito has four sides, in one of which stands the cathedral, and in the opposite the episcopal palace; the third side is taken up by the town-house, and the fourth by the palace of the audience: this square is very spacious, and has in its centre an elegant fountain. The four streets terminating at the angles of the square are straight, broad, and handsome; but at the distance of three or four *quadrads*, (each quadra being about one hundred yards,) the troublesome declivities commence; and on this account the inhabitants cannot enjoy the benefit of coaches, or wheel carriages. The principal streets are paved; and those which are not paved are almost impassable after rain, which is here very common. Besides the principal square, there are two others, that are very spacious, and several that are smaller. In these most of the convents are situated, and these make a handsome appearance, and some of them, particularly that of the order of Franciscans, are elegant structures. The principal houses are large, and some of them have spacious and well-contrived apartments, though none are above one story in height, but their doors and windows are low and narrow. The materials made use of in building at Quito are "adobes," or unburnt bricks and clay, cemented by a substance called "sangagua," a species of mortar that is uncommonly hard, used by the ancient Indians for building all kinds of houses and walls. The city is divided into seven parishes; the cathedral is richly adorned with tapestry hangings and other costly decorations; but the parish churches are of mean appearance. The convents of monks are those of the Augustines, Dominicans, and Fathers of Mercy, &c. colleges, &c. Quito has also several nunneries. The college of Jesuits, as well as all the convents of monks, are large, well built, and very splendid. Here is also an hospital, with separate wards for men and women, under the name of the order of our Lady of

of Bethlehem. Among the courts whose sessions are held at Quito, the principal is that of the Royal Audience, established there in 1563; the exchequer or chamber of finances, a treasury for the effects of persons deceased, &c. The corporation consists of a corregidor, two ordinary alcaldes chosen annually, and regidores. The cathedral chapter consists of the bishop, dean, archdeacon, chanter, treasurer, a doctoral, a penitentiary, a magistral, three canons by presentation, four prebends, and two demi-prebends, with the following salaries; that of the bishop 24,000 dollars, the dean 2500, the four succeeding dignities 2000 each, the canons 1500 each, the prebends 600, and the demi-prebends 420. This church was created into a cathedral in 1545, and among other festivals celebrated in it, the most magnificent are those of Corpus Christi, and the Conception of our Lady, when all the courts, offices, and persons of eminence assist. In the former there is a singular pomp of the procession of the host, and here are also dances of a peculiar nature, which were performed before their conversion to Christianity. The corporation and cathedral chapter keep, by vow, two annual festivals in honour of two images of the Virgin, which are placed in the villages of Guapulo and Quincha, belonging to this jurisdiction. These images or statues are brought with great solemnity to Quito, and each festival is succeeded by nine days' devotion, the audience and other courts assisting on the occasion. These festivals are held in commemoration of the assistance vouchsafed by the holy Virgin, at the time of an earthquake and terrible ejection from Pichincha, by which Latacunga, Hambato, and a great part of Riobamba, were utterly destroyed; whereas by the supposed interposition of the Virgin, the city escaped even the slightest damage.

The celebrated city of Quito is said by Alcedo to contain 58,000 persons, some of whom are distinguished by their rank. These are the descendants either of the original conquerors, or of other persons who in succeeding times came over from Spain invested with some lucrative office, and who have preserved the lustre, both of their descent and wealth, by intermarriages, without mixing with meaner families though famous for their riches. The lower orders of people consist of four classes, Spaniards or whites, Mestizos, Indians or natives, and Negroes, with their progeny. The former, according to the statement of Ulloa, compose about a sixth part of the population; the Mestizos, or descendants of Spaniards and Indians, amount to about a third part; the Indians form about another third; and the others, who are about one-sixth, are the Casts. The Spaniards are prevented by their pride from applying to any kind of business, and therefore many of them are poor and wretched. The Mestizos occupy themselves in arts and trades, but principally in those of the highest repute, such as painting and sculpture, in which they excel. These men of talents, however, are indolent and slothful, so that they loiter about the streets during the whole day. The Indians, who are generally shoemakers, bricklayers, weavers, or engaged in similar occupation, are not more industrious. Persons of fortune among the Spaniards affect great magnificence in their dress, wearing the finest gold and silver tissues; but that of the middling and lower class is a black cloak, and under it a long coat, reaching down to their knees, with a close sleeve, open at the sides, without folds, and ornamented with rows of buttons. The Mestizos generally wear blue cloth, manufactured in this country. The dress of the Indians consists only of white cotton drawers, made either from the stuffs of the country, or from others brought from Europe, reaching down to the calf of the leg, and edged with lace suitable to the stuff. The use of a shirt is

supplied by a black cotton frock, wove by the natives; and over this is a kind of serge cloak, through which the head passes, and a hat made by the natives. The men, both Creoles and Spaniards, are well made, of a proper stature, and of a lively agreeable countenance. The Mestizos in general are also well made, often taller than the ordinary size, very robust, and have an agreeable air. The Indians, both men and women, are generally low, but well proportioned and very strong. The Indians have no beard, nor have either males or females any indications of the age of puberty. The youths of family are instructed in philosophy and divinity, and some, with reluctance, proceed to the study of the civil law. The country is observed to abound more in women than men; and it is observed, that nature begins to decay at the age of thirty in the male sex, especially among those who have been tenderly brought up; whereas the females enjoy a more confirmed state of health and vigour. This difference is ascribed partly to the climate and partly to the food, but principally to early intemperance and voluptuousness, and also the want of proper employments. The liquors that are used here are rum and brandy, in which they freely indulge, and also the infusion of the Paraguay herb, which serves for tea. The vices prevalent here are idleness, drunkenness, and gaming. The common people and Indians are much addicted to theft, in which they are very artful and dextrous. In Quito, and in all the towns and villages of its province different dialects are spoken, Spanish being no less common than the Inga.

Quito is so happily situated, that neither the heat nor cold is troublesome; though the extremes of both may be felt in its neighbourhood. An equality of temperature takes place throughout the whole year, the difference between the seasons being scarcely perceptible. The winds are salubrious, and blow continually, but never with any violence. The rain occasionally descends in impetuous torrents. Earthquakes are not uncommon, and when they occur very violent; that of 1775 was very destructive. The great earthquake on the 4th of February 1797, which changed the face of the whole province, and in one instant destroyed thirty-five or forty thousand persons, has so altered the temperature of the air, that the thermometer is now commonly 41° to 54°, and seldom rises to 68° or 70°; whereas Bouguer observed it constantly at 66° or 68°. Since this catastrophe earthquakes are continually recurring; and such shocks, it is probable, that all the higher ground is one vast volcano. Von Humboldt adds, that what are called the mountains of Cotopaxi and Pichincha are but little summits, the craters of which form different conduits terminating in the same cavity. The earthquake of 1797 afforded a melancholy proof of this; for the ground then opened every where, and vomited forth sulphur, water, &c. Notwithstanding the dangers and horrors that surround them, the people of Quito are gay, lively, and variable, and very much addicted to pleasure, luxury, and amusement. Humboldt informs us, that the volcanos of Quito eject pumice, basalt, and porphyry scorified; with enormous quantities of water and liquid clay, which diffuse fertility eight or ten leagues round. The fertility of this country is such, that, as we are informed, a full description of it would appear incredible. The equability of the climate, as well as the fertility of the soil, occasion a regular succession of the productions of the earth: when the fruits have obtained their maturity, and the leaves begin to change their colour, fresh leaves, blossoms, and fruits, are seen in their proper gradations on the same tree. The same incessant fertility is conspicuous in the corn, reaping and sowing being both carried on at the same time. This remarkable fecundity of the soil is naturally productive of excellent

excellent fruits and corn of every kind, as is evident from the delicacy of the beef, veal, mutton, pork, and poultry of Quito. One of the principal foods used by the inhabitants is cheese, of which it is computed that the quantity annually consumed amounts to between seventy and eighty thousand dollars of the money of that country. The vicinity also affords excellent butter. The manufactures of this province are cottons, some white, called *tucuyos*, and others striped bays and cloths, which meet with a good market at Lima, for supplying all the inward provinces of Peru; and the returns are made partly in silver, and partly in gold and silver fringes made in that city, wine, brandy, oil, copper, tin, lead, and quicksilver. The products of the earth are chiefly consumed within the province; except the wheat, part of which is sent to Guayaquil. But this trade is carried on by Mestizos and poor people. Goods, manufactured by the public, or woven by private Indians, are sent, together with some kinds of provisions, to the jurisdiction of Barbacoas. These provisions are exchanged for gold, found in that country, and which is afterwards sent to Lima, and disposed of at a greater price. Their stuffs find a vent in the governments of Popayan and Santa Fé. The coast of New Spain supplies this province with indigo, of which a great quantity is consumed; blue being universally the colour which these people affect in their apparel. They also import, by way of Guayaquil, iron and steel, both from Europe and the coast of Guatemala. S. lat. $0^{\circ} 13' 27''$. W. long. $78^{\circ} 10' 15''$. Ulloa's Voyage, vol. i.

QUIT-RENT, *q. d. quiet rent*, a certain small rent, payable yearly, by the tenants of most manors, in token of subjection; upon the payment of which, they are quiet, and free. It includes both rents of assise and chief rents.

These rents differ very greatly in different manors, being in some a mere trifle, while in others they are very heavy and oppressive to the tenants. This part of the feudal system is now considerably on the decline.

In some ancient records it is written white rent, because paid in silver, to distinguish it from rent-corn, rent-pepper, &c.

QUITTA, in *Geography*, a town of Africa, on the Slave coast. N. lat. 6° . E. long. $0^{\circ} 8'$.

QUITTANCE. See **ACQUITTANCE**.

QUITTER, or **QUITTOR**, in horses, is an ulcer formed between the hair and hoof, usually on the inside quarter of a horse's foot; it often arises from treads and bruises, sometimes from gravel, which by working its way upwards, lodges about the coronet; if it is only superficial, it may be cured with cleansing dressings, bathing the coronet every day with spirits of wine, and dressing the fore with lime-water, or a detergent application, such as red precipitate. But where the matter forms itself a lodgment under the hoof, there is then no way to come at the ulcer but by taking off part of the hoof; and if this be done well, the cure may be effected without danger.

When the matter happens to be lodged near the quarter, the farrier is sometimes obliged to take off the quarter of the hoof, and the cure is then for the most part but palliative; for when the quarter grows up, it leaves a pretty large seam, which weakens the foot; this is what is called a false quarter, and a horse with this defect seldom gets quite sound.

If the matter, by its confinement, has injured or destroyed the coffin-bone, which is of so soft and spongy a nature that it soon becomes carious, it will be necessary to enlarge the opening, cut away the spongy flesh, and apply the actual cautery, or hot iron, pointed pyramidically, dressing the bone with doffils of lint dipped in tincture of myrrh, and the wound with the green or precipitate ointment. When the fore is not enlarged by the knife, which is the best and

least painful method, sublimate is generally applied; or blue vitriol powdered, and embued with a few drops of oil, is also used for this purpose, and is said to act as effectually, and with less pain to the animal.

In the time of the action of these caustic remedies, the foot should be kept in a poultice. And where sinuses form they should be laid open by a knife, and be afterwards stimulated by the application of some detergent remedy. The following has been advised by a late writer: Take of corrosive sublimate, red precipitate in fine powder, of each equal parts; honey sufficient to form a paste.

The wound is advised to be afterwards dressed with common digestive ointment, pressure being given by means of a bandage. It is sometimes written quitor.

QUITTER-Bone, another term applied to the same disease by farriers and persons engaged in husbandry.

QUITY, in *Botany*, a Brazilian name used by some authors for the *sapindus*, or soap-berry tree of the West Indies.

QUIVER, seemingly corrupted from the Fr. *couverir*, to cover, a case or sheath for arrows.

QUIVISA, in *Geography*, a town of Hindoostan, in Bahar; 25 miles S.W. of Bettyah.

QUIVISIA, in *Botany*, from the vulgar name of this tree or shrub in the isles of Bourbon and the Mauritius, *bois de quivi*. Juss. Gen. 264. Cavan. Diss. 367. (See **GILBERTIA**.) One cannot but wonder how a writer of Jussieu's learning could, for a moment, tolerate so faulty a name; especially as his authority leads heedless persons into the adoption of such, for want of reading his preface; where, in a note to p. 24, he declares these rude and barbarous names to be merely borrowed for a time, till the genera to which they belong are better determined.

QUIXOS, in *Geography*, a jurisdiction of South America, attached to the province of Quito, on the east side of the Cordillera of the Andes. Quixos on the north side borders on the jurisdiction of Popayan; reaching eastward to the river Aguarico, and towards the west separated from the jurisdictions of Quito, Latacunga, and the town of San Miguel de Ibarra, by the Cordilleras of Cotopaxi and Cayamburo. This country was first discovered, in 1536, by Gonzalo de Pineda, one of the officers sent from Popayan by Sebastian de Belalcazar (or Benalcazar), to trace the course of the river Magdalena; and in consequence of his report, Gonzalo Pizarro, in 1539, reconnoitred its whole extent, and established settlements in it. But upon the failure of his expedition, the conquest of this country was suspended till the year 1549, when the marquis de Canete, viceroy of Peru, gave a commission to Gil Ramirez Davalos, a man of undaunted courage, for reducing the Indians, and making settlements in the country. This object he accomplished, and founded the town of Baeza, the capital of the government, in the year 1559; and this was soon followed by other towns and villages, the principal of which are Archidona and Avila. The temperature of this country is hot and moist, the rains being almost continual. It is covered with thick woods, some trees being of a prodigious magnitude. In the S.W. part of the jurisdiction of Quixos is the canela or cinnamon tree, which led Gonzalo de Pineda to call the country Canelos, a name which it still retains. The other products of Quixos are the same with those in all the other lands under the same climate as this government. Adjoining to this is the district of Macas and Maynas. See **MACAS** and **MAYNAS**.

QUIZA, in *Ancient Geography*, a town of Africa, in Mauritania Caesariensis. This was a fortress, according to Pomponius Mela and Pliny. Antonine makes it a municipality, and places it between Portus Magnus and Arsenaria.

QUIZAMA, in *Geography*, a province of Africa, in the southern part of Angola; the country is extensive, mountainous, and badly cultivated; but it produces abundance of honey, wax, and salt. The inhabitants are warlike, and have not submitted to the Portuguese.

QUIZIBA, a small island in the Indian sea, near the coast of Africa. S. lat. $12^{\circ} 30'$.

QUIZIMAJUGO, a river of Africa, which discharges itself into the Indian sea, S. lat. $8^{\circ} 50'$.

QUIZINA, or **TEUSIN**, a chain of mountains in Fez, 90 miles in extent.

QUIZUMGO, a river of Africa, which runs into the straits of Mozambique, S. lat. $17^{\circ} 20'$.

QUO JURE, in *Law*, a writ that lies for him who has land, wherein another challengeth common of pasture time out of mind: its design is to compel the party to shew by what right or title he challengeth it. This is now out of use, as, on the claimant's putting his cattle in, the owner may bring trespass, when the claimant must plead and prove his title.

Quo Minus is also a writ which lies for the king's farmer or debtor in the court of exchequer, against him to whom he selleth any thing by way of bargain, touching his farm, or against whom he hath any cause of personal action; because by the vendee's detaining any due from him, the farmer is less able to pay the king's rent. This was formerly allowed only to such persons as were tenants or debtors to the king: at this day the practice is become general for the plaintiff to surmise, that, for the wrong which the defendant doth him, he is less able to satisfy his debt to his majesty; which surmise gives jurisdiction to the court of exchequer to hear and determine the cause. Finch. 66. Old N.B. 148.

Quo minus is also a writ that lies for him who has a grant of house-bote and hay-bote in another man's woods, against the grantor making such waste, as that the grantee cannot enjoy his grant.

Quo Warranto, a writ that lies against any person or corporation (which see) who usurps any franchise, or liberty, against the king; as to have waife, tway, fair, market, court baron, leet, or such like, without good title; to inquire by what authority he supports his claim, in order to determine the right. Finch. L. 322. 2 Inst. 282.

It also lies for mis-user or non-user of privileges granted; and even, according to Bracton, against him that intrudeth himself as heir into land. See **INTRUSION**.

This writ was originally returnable before the king's justices at Westminster; but afterwards only before the justices in eyre, by virtue of the statutes of "quo warranto," 6 Edw. I. c. 1. and 18 Edw. I. st. 2. (2 Inst. 498. Rast. Entr. 540.) ; but since those justices have given place to the king's temporary commissioners of assize, the judges on the several circuits, this branch of the statutes hath lost its effect: and writs of "quo warranto" (if brought at all) must now be prosecuted and determined before the king's justices at Westminster. And in case of judgment for the defendant, he shall have an allowance of his franchise; but in case of judgment for the king, for that the party is entitled to no such franchise, or hath disused or abused it, the franchise is either seized into the king's hands, to be granted out again to whomever he shall please; or, if it be not such a franchise as may subsist in the hands of the crown, there is merely judgment of "ousting," to turn out the party who usurped it. Cro. Jac. 259. 1 Show. 280.

The judgment on a writ of *quo warranto* (being in the nature of a writ of right) is final and conclusive even against the crown. (1 Sidd. 86. 2 Show. 47. 12 Mod. 225.) This

circumstance, together with the length of its process, probably occasioned that disuse into which it is now fallen, and introduced a more modern method of prosecution, by information filed in the court of king's bench by the attorney general, in the nature of a writ of "quo warranto," in which the process is speedier, and the judgment not quite so decisive. This is properly a criminal method of prosecution, as well to punish the usurper by a fine for the usurpation of the franchise, as to oust him, or seize it for the crown; but hath long been applied to the mere purposes of trying the actual right, seizing the franchise, or ousting the wrongful possessor; the fine being nominal only. Blackst. Com. b. iii. See **INFORMATION**.

QUOAD HOC, a term often used in law reports to signify, "as to the thing named" the law is so, &c.

QUOCOLOS, the name of a stone found in Tuscany, as hard as a flint, somewhat transparent, and, in some measure, resembling marble. In the fire it loses its transparency, and becomes less ponderous, and white; and a strong fire readily converts it into glass. It has no medicinal virtues, but is used at some glass-houses.

QUOD, CAPE, or *Quada*, a cape on the coast of Patagonia, in the straits of Magellan. S. lat. $53^{\circ} 33'$. W. long. $74^{\circ} 6'$.

Quod clerici beneficiati de cancellaria, in *Law*, a writ to exempt a clerk of the chancery from the contribution towards the proctors of the clergy in parliament. Rep. Orig. 261.

Quod clerici non eligantur in officio ballivi, &c. is a writ that lies for a clerk, who, by reason of some land he hath, is made, or like to be made, a bailiff, beadle, reeve, or such like officer.

Quod cum, that whereas, being by way of recital, and not positively, is not good in indictments. 3 Salk. 188. See **INDICTMENT**.

Quod ei deforceat, a writ for tenant in tail, tenant in dower, by the courtsey, or for term of life, having lost their lands by default, against him that recovers, or his heir. Reg. Orig. 171. Stat. Westm. 2. cap. 4.

This, though not strictly a writ of right, so far partakes of the nature of one, as that it will restore the right to him who has been thus unwarily deforced by his own default. (F.N.B. 155.) But in case the recovery were not had by his own default, but upon defence in the inferior possessory action, this still remains final with regard to these particular estates, as at the common law: and hence it is, that a common recovery (on a writ of entry in the *possi*) had, not by default of the tenant himself, but (after his defence made, and voucher of a third person to warranty) by default of such voucher, is now the usual bar to cut off an estate-tail.

This writ may be brought against a stranger to the recovery; as if a man recover by default, and maketh 2 feoffment, this writ may be had against the feoffee.

Quod medium. See **MEDIUM**.

Quod permittat, in *Law*, a writ that lies where a man is disseised of his common of pasture, and the *disseisor* aliens or dies seized, and his heir enters; then if the disseisee die, his heir shall have this writ. See **DISTURBANCE of Common**.

Quod permittat profernere. See *Assize of NUSANCE*.

Quod persona nec prebendarii, &c. a writ that lies for spiritual persons, when distrained in their spiritual possessions, for the payment of a fifteenth, with the rest of the parish. F.N.B. 176.

QUODLIBETICAL QUESTION, *Quæstio quodlibetica*, a college term for a thesis, or problem, anciently proposed to be debated in the schools, out of curiosity and entertainment, rather than for the settling of any useful point.

The term is formed from the Latin *quodlibet*, *any thing, what you please*: and so well satisfied were the public of the impertinences of these questions, that the term *quodlibet* has been since retained, to signify any little ridiculous quibble.

QUOJA, in *Geography*, a country of Africa, situated above 100 miles from the coast of the Atlantic, between the 8th and 10th degrees of W. longitude, and between the 7th and 9th degrees of N. latitude.

QUOIF, in *Ship-Building*, a piece of oak thickstuff on the deck-hook, to which the deck water-way on each side is butted, otherwise the butt would come in the middle, and could not be caulked.

QUOIL, QUOYL, or *Coile*, in the *Sea Language*. A cable is said to be quailed, when it is laid round in a ring, one turn over another, on the deck of a ship.

The middle of such ring, or quail, is a good place to lay shot in: they are more safe there, than in lockers along the side, where the enemy's shot may fall into them.

QUOIL, *Weather*. See *WEATHER Quail*.

QUOIN, or COIN, formed from the French *coin*, of the Latin *cuneus*, *wedge*, aboard a ship, is a wedge fastened on the deck, close to the breech of the carriage of a gun, to keep it firm up to the ship's side, and prevent its rolling; and also to raise or depress it.

QUOINS, *Cantic*, are short three-legged quoins, put between casks to keep them steady. See *COIN*.

QUOINS, in *Architecture*, denote the corners of brick or stone walls.

The word is particularly used for the stones in the corners of brick buildings. When these stand out beyond the brick-work (their edges being chamfered off) they are called *rustic quoins*.

QUOIN, in *Geography*, a small island in the Indian sea, near the W. coast of Madagascar. S. lat. 14°. E. long. 48° 14'.—Also, an island in the East Indian sea, N. of the Nicobar islands. N. lat. 9° 56'. E. long. 93° 20'.

QUOITS, a kind of exercise or game, known among the ancients under the name of the *discus*. See *DISC*.

QUOLL, in *Zoology*, a name given by the natives of New Holland to an animal resembling a pole-cat, with a brown back, spotted with white, and the belly of a pure white, in which it differs from others of these fetid animals. Cook's Voy. 1770. vol. iii. p. 626.

QUONDANGA, in *Geography*, a town of the Birman empire; 32 miles N. of Prone.

QUORUM, a term frequently mentioned in our statutes, and often used in commissions, both of peace, and others. A justice of the quorum is thus called from the words in the commission, *Quorum C. D. or A. B. aliquem vestrum unum esse volumus*.

For an example: where a commission is directed to seven persons, or to any three of them, of which A. B. and C. D. are to be two; there A. B. and C. D. are said to be of the quorum, because the rest cannot proceed without them.

So a justice of the peace and quorum is one without whom the rest of the justices, in some cases, cannot proceed. See *JUSTICES of the Peace*.

QUORUM Nomina. In the reign of king Henry VI. the king's collectors, and other accountants, were much perplexed in passing their accounts, by new extorted fees, and forced to procure a then late-invented writ of *quorum nomina*, for the allowance and suing out their quietus, without the allowance of the king.

QUOTA, in *Law*, a tax to be levied in an equal manner.

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QUOTATION, in *Literature*, a citation; or a passage rehearsed expressly in one author from another.

Quotations are usually distinguished by inverted commas.

The manner of quoting by book, and chapter, or section, is chiefly affected by men of erudition; but it is abused: this method ought only to obtain where the whole chapter or section is expressly on the subject. On other occasions, quoting by page is more commodious; except in classics, and other ancient writings, of which there are many editions in different forms; where this method is of little use, unless the edition be also specified.

The quotations from the Old Testament, found in the New, have occasioned great doubt, dispute, and criticism. The apostles are frequently referring to the Old Testament, and quoting passages and prophecies thence, as fulfilled in our Saviour; yet these passages, thus quoted, are frequently either not found in the Old Testament at all, or they are not urged in the New, according to the literal and obvious sense they seem to bear in the Old.

A late ingenious author, in an "Essay upon the Truth of the Christian Religion," frankly owns, that the evangelists sometimes apply to the Messiah passages of the Old Testament, which, as they lie in our present copies, plainly relate to some other person, or thing. This is evident, *e. gr.* in the passage, Matthew, ii. 15. *Out of Egypt have I called my son*; which is quoted from Hosea, xi. where it is plainly understood of the coming of the Israelites out of Egypt.

This circumstance has been urged as a great objection to Christianity, which the divines, commentators, critics, &c. have long laboured to remove, though by very different means.

Some have recourse to a double completion; and imagine, that though the prophecies were primarily accomplished in other events, yet they might have a secondary accomplishment in the Messiah: but others set aside a double completion, except where the prophet himself declares as much, this otherwise making all prophecy useless. See *PROPHECY*.

The generality choose, therefore, to have recourse to an allegorical, typical, or spiritual meaning in the prophecies, &c. and suppose them to have been thus understood among the ancient Jews, thus fulfilled in our Saviour, and thus applied by the apostles.

In effect, the Jewish rabbins, it is allowed, took great liberty in quoting and interpreting scripture; and it is supposed the apostles might follow these rules in their quotations.

Accordingly, M. Surenhusius, Hebrew professor at Amsterdam, has endeavoured to retrieve these rules, long since lost, in an express treatise on this subject, published in 1713. This author observes a great deal of difference applied in the different forms of quoting used by the sacred writers: as, *It has been said; it is written; that it might be fulfilled which was spoken by the prophets; the Scripture says; see what is said; the Scripture foreseeing; it is not written*, &c. He adds that the books of the Old Testament having been disposed in a different order at different times, and having had different names, it is thence, that one book or writer is sometimes confounded with another.

For the rules of quoting and interpreting practised among the rabbins, he gives us ten; recovered with much study from the Talmud, and the ancient Jewish doctors: instances of which he gives us in the writings of the apostles; and by those rules he endeavours to explain and justify all the quotations made from the Old Testament in the New.

The rules are, 1. Reading the words not according to the

the points placed under them, but according to others substituted in their stead; as is done by St. Peter, Acts, iii. 23. by Stephen, Acts, vii. 43. and by Paul, 1 Cor. xv. 54. 2 Cor. viii. 15, &c. The second is by changing the letters; as is done by Paul, Rom. ix. 33. 1 Cor. xi. 9 Heb. viii. 9. and x. 5. and by Stephen, Acts, vii. 43. The third is by changing both letters and points; as is done by Paul, Acts, xiii. 41. and 2 Cor. viii. 15. The fourth is by adding some letters and taking away others. The fifth is by transposing words and letters. The sixth is by dividing one word into two. The seventh, adding other words to make the sense more clear. The eighth, changing the order of the words. The ninth, changing the order of the words and adding other words. Both of which are done by the apostles. And lastly, changing the order of words, adding words, and retrenching words; which is a method often used by St. Paul.

Other authors, as bishop Kidder, M. le Clerc. Mr. Sykes, &c. solve the difficulty another way. That usual form of quotation among the evangelists, "That it might be fulfilled which was spoken by the prophets," according to these authors, means no more than an accommodation of the prophet's words to the case in hand.

The word *πληρωθης*, fulfilled, does not necessarily determine us to such a sense, as if the evangelists designed to speak of a prediction of future events *accomplished*; but may barely express an accommodation of borrowed words. In effect, says bishop Kidder, a scripture may be said to be fulfilled two ways; *properly*, as when that which was foretold comes to pass; and *improperly*, by way of accommodation, as when an event happens to any place or people like to what fell out some time before. And thus it is that St. Matthew says, on occasion of the murder of the innocents, that "then was fulfilled what was spoken by the prophet Jeremy, *In Rama was a voice heard*," &c.

This interpretation is confirmed by M. le Clerc, who observes that the Jews, in their language, used to say, that a passage of scripture was fulfilled, as often as any thing happened to which it might be applied; so that the evangelist Matthew, who was a Hebrew, and wrote, as is commonly supposed, in that language, intended no more in the passage just cited, but that a thing happened, to which one might apply what Jeremy had formerly said on another occasion.

Accordingly, says Mr. Sykes, the evangelists, in citing that passage of Isaiah, *Behold, a virgin shall be with child*, &c. only use it as words of that prophet remarkably agreeing to the miraculous birth of Jesus, and not as a prophecy of his birth.

It may be added that this way of speaking was not unknown among the heathen writers. Thus in Ælian, Diogenes Sinopenis used continually to say of himself, that he fulfilled and underwent all the curses of tragedy.

The difficulty stated in this article has been already the subject of discussion under the terms ACCOMMODATION and PROPHECY. Whilst it is allowed, that many passages in the New Testament, and also in the writings of the Christian fathers, are very different from the correspondent passages as they now stand in the Hebrew text; and that some words are introduced as quotations which are no where to be found: those who urge the objection should be disposed to pay due attention to the various modes of replying to it, which biblical critics have proposed. Some have supposed, with Whiston, that those early Christian writers quoted from the LXX: others have alleged that they sometimes quoted from their memory; and this, it is said, is the more probable, because the same passage is quoted in some cases by different authors

in very different words, even where the sense agrees. It is moreover alleged, that the *sense* of the passages supposed to be lost is still to be found in the Old Testament, though the *words* be not; such especially are Matt. ii. ult. and John, vii. 38. But if it were granted, that some of the verses originally belonging to the Old Testament are lost, or materially corrupted, no objection could be justly alleged against the authenticity and divine authority of the sacred writings in general. As for the quotations that occur in the New Testament, the most probable opinion is, that some of them are made from the Greek version and some from the Hebrew text. To those who assume, that though such quotations are made from the Greek version, where that differs from the Hebrew, yet both the text and the version are in such places always the same in sense, we reply with Dr. Kennicott, that this is not the case: and he thinks, that the only way of doing justice to our Saviour and his apostles in their references to the Old Testament, is to say, that for whatever purpose such quotations were made (whether by way of express prophecy, or only of allusion and accommodation) they were always consonant to the true sense of the Hebrew text. For he says, it is scarcely possible to conceive, how any speaker or writer can quote justly such and such words, as (e. g.) from Moses or from Isaiah, when the words quoted are not the words of Moses or Isaiah, and do not express even the sense of Moses or Isaiah; but are only taken from some version, which (upon the present supposition) was no version at all in these instances, because it did not agree here in sense with its original. The foundation of this mistake, as this learned writer adds, is the notion that has prevailed of the integrity of the modern Hebrew text; for the writers who have held this to be perfect, have never been able and never will be able to vindicate the prophetic quotations. Passages quoted from the several Jewish writers by inspired men must (he thinks) have been quoted agreeably to the sense of the Hebrew text; but such quotations do not agree in sense with the printed Hebrew text. Therefore some alterations have happened, either in the Greek text of the New Testament, or the Hebrew text of the Old. Collins says that the Hebrew text has been delivered down perfect, and therefore that the quotations are either forged or falsified in the New Testament. To this it is replied, that as it appears from a collation of the Greek MSS. of the New Testament, that the words of the quotations are not corrupted in the Greek text, so it appears from a collation of the Hebrew MSS. that the words have been corrupted in the Hebrew. And this is an answer which should approve itself to all Christians. See Kennicott's State of the Hebrew Text, vol. ii. p. 345—347, &c.

Upon the whole we observe, that the writers of the New Testament did not make it a constant rule to quote from the Greek version, because there are many places where their quotations differ from that version and agree with the Hebrew. And as the quotations now agree with the Hebrew, frequently in the express words, generally in the sense; so it is most probable, that they always agreed at first, and that where the Hebrew was expressed properly in the Greek version, they used the words of that version; and where the version was not proper, they translated for themselves.

With regard to Matt. ii. ult. the first of the passages above cited, Dr. Doddridge (Fam. Expof. in loc.) observes, that Nazareth was a little city on the confines of Zabulon and Issachar; so contemptible among the Jews, that it was a proverb among them, No good thing can be expected from thence. Thus was fulfilled what was spoken in effect by many of the prophets, "he shall be called a Nazarene;" i. e. he shall

shall appear in mean and despicable circumstances, and be treated as the mark of public contempt and reproach. If this sense be not approved, Dr. Doddridge professes to acquiesce in Chrysostom's opinion, that the passage referred to is lost, avouching his dissatisfaction with other interpretations of this passage. The second passage, viz. John, vii. 38, our learned expositor thus explains. "He that believeth in me, as the scripture hath said, out of his belly shall flow rivers of living water, i. e. as the scripture has in many places said and promised, he shall receive those supplies in so great an abundance, that he shall not only be refreshed himself, but out of his belly, or from within him shall flow vital streams, and as it were rivers of living water for the refreshment and comfort of others." Chrysostom, and after him many other eminent writers, Castilio, Zegerus, and I. Capellus, refer the words "as the scripture hath said," to the former clause, and understand them, as if our Lord had said, "He that hath faith in me," which the scripture requires, and thus they avoid the difficulty, which arises from our not finding the following words in scripture. But Grotius, with whom Dr. Doddridge agrees, supposes, that here is a general reference to the several prophecies which refer to the effusion of the spirit by the Messiah, under the

similitude of pouring out water. See Isaiah, lii. 15. xlii. 3. lviii. 11. Joel, ii. 28.

QUOTIDIAN, in *Medicine*, signifying literally *daily*, is applied to all intermitting diseases, which return once in twenty-four hours. As the most remarkable of these is the *ague*, or intermitting fever of marshy countries; so the term *quotidian* signifies emphatically a quotidian *ague*. The paroxysm usually returns in the morning. See *AGUE*.

QUOTIDIAN, *Double*, returns twice in twenty-four hours.

QUOTIENT, QUOTIENS, formed from the Latin *quoties*, *q. d. how often is such a number contained in such another*, in *Arithmetic*, the number resulting from the division of a greater number by a smaller; and which shews how often the smaller is contained in the greater, or how oft the divisor is contained in the dividend.

In division, as the divisor is to the dividend, so is unity to the quotient. Thus the quotient of 12 divided by 3 is 4; which is thus disposed, 3) 12 (4 quotient.

QUOVEDO, in *Geography*, a town of Iltria; six miles E. of Capo d'Iltria.

QUOUSQUE. *Execution with a Quousque*. See *EXECUTION*.

QUOYL. See *QUOIL*.

R.

R, A liquid consonant, and the seventeenth letter of the alphabet.

The grammarians hold it a semi-vowel; especially in the Greek, where, in common with the other vowels, it admits an aspirate, &c. though whether the aspirate should be sounded before or after it, is some doubt. We find instances of each.

Thus *ῥέδν* the Latins wrote *rheda*; and *ῥόδον* the Ætoliens wrote *ῥόδον*; and in English words derived from the Greek it is followed by an *h*, as *rhapsody*. The ancient Goths, and Teutones, Littleton observes, always prefixed *h* to *r*. See *H*.

The sound is formed by a guttural extrusion of the breath, vibrated through the mouth, with a sort of quivering motion of the tongue drawn from the teeth, with the tip a little elevated towards the palate.

In some words, as *Rome*, *rape*, and *river*, it has a rough sound; in others, as *bard*, *card*, *regard*, its sound is smooth. *Re* at the end of many words is pronounced like a mute *er*, as in *theatre*, *sepulchre*, and *massacre*. *Rh* is used in words derived from the Greek, as *myrrh*, *rheum*, and *rhyme*.

The Hebrews allow the *r*, or ר, the privilege of a guttural; that is, they never double it, which yet is done by the Arabs, Greeks, and Latins, &c.

Persius calls the *r*, *litera canina*, because the dogs seem to pronounce it in snarling; yet it should seem to have had a softer sound among the Romans than among us, by its being frequently interposed to prevent the clashing of vowels; as in *rarus*, *αῖροι*; *nurus* from *νους*; *murex* from *μυρξ*; *mus muris* from *μυρ μῆρος*; and this softness was such as frequently oc-

casioned its being dropt as useless in writing. Thus for *Hetrusci* they frequently wrote *Thusci*, and even *Tusci*; and for *sursum*, *rursus*, *prorsus*; *susum*, *rusus*, *profus*.

In effect, there was that agreement between the sound of the *s* and *r*, that as the Romans avoided the doubling of their consonants, it was no wonder they here dropped the *r* in such words; the *s* supplying the place of both. Hence too it came to pass, that what they at first pronounced *asa*, *asena*, *casimen*, was afterwards *ara*, *arena*, *carmen*; and those first named *Fusii* and *Valesii*, were afterwards called *Furii* and *Valerii*. Cicero tells us, the *Papirii* were first called *Papisii*; and even fixes the time when the change was made, viz. in the year of Rome 415. Festus adds, that *olera*, *pignora*, *plurima*, were anciently written *olesa*, *pignosa*, *plufima*.

From the same softness of the sound of the *r*, it came to be used indifferently with the *l*, in many words; e. gr. *Latiaris* and *Latialis*, *Palitia* and *Parilia*, &c.

Though the *r* more frequently degenerated into *l*; thus *remures* became changed into *lemures*; *interlego*, *perluzeo*, into *intelligo* and *pelluceo*; *frater* into *fratellus*, &c.; and the same is sometimes done between *n* and *r*, as *arcus*, and *eneus*, &c.

In the notes of the ancients, *R*. or *RO*. signified *Roma*; *R. C. Romana civitas*; *R. G. C. rei gerendæ causa*; *R. F. E. D. recte factum et dictum*; *R. G. F. regis filius*; *R. P. res publica*, or *Romani principes*; and *R. R. R. F. F. F. res Romana ruet ferro, fame, flamma*.

R was anciently a numeral letter, signifying 80; according to the verse,

"Octoginta dabit tibi R, siquis numerabit."

When a dash was added at top, as $\overline{R}$, it signified eighty thousand.

The Greek ρ , ρ , with a small mark over it, signified a hundred; with the same mark under it, it denoted 1000×100 ; thus ρ signified 100,000.

In the Hebrew numeration, γ denoted 200; and with two horizontal points over it, 1000×200 ; thus $\ddot{\gamma} = 200,000$.

R on the French coins, denotes their being struck at Orleans.

R, or R, in *Medicinal Prescription*, stands for *recipe, take*.

RAA, in *Geography*, a town of Norway; 10 miles N.E. of Frederickstadt.

RAAB, GYOR, or *Javarin*, a town and fortress of Hungary, situated in a pleasant level country, at the conflux of the Danube, the Raab, and Rabnitz, which surround it. Its houses are constructed of stone, and its streets are large and straight. It is the see of a bishop. Its fortification consists of seven bastions, and it has always a strong garrison, provided with military stores. The fortifications of the city and castle are chiefly the works of the emperors Ferdinand I. and Maximilian II. In this place are seen some Roman antiquities; 56 miles S.E. of Vienna. N. lat. $47^{\circ} 42'$. E. long. $18^{\circ} 45'$.

RAAB, a river of Stiria, which rises near mount Retzlstein, and runs into the Danube, near Raab in Hungary.

RAAF, or RAFF, ANTHONY, in *Biography*, the most exquisite and celebrated tenor singer of the last century, was born at Bonn in 1710. He was a scholar of Bernacchi, and equally admired for his taste, expression, and style of singing, by the Italians and Germans. In 1729 his voice was settled from a high treble to a sweet and firm tenor, sufficiently for him to perform a capital part in an opera at Naples. After singing in all the great cities of Italy, he returned to Germany, where he was courted and caressed by all the princes of the empire. He was knighted by the elector of Bavaria, and appointed his chamber musician. In 1751 he performed again at Naples in Metastasio's "Attilio Rigolo," with the Mingotti, and in the letters of Metastasio of that period, we have the poet's opinion of his performance. (Mem. of the Life and Writings of Metastasio, vol. i. p. 403.) He performed in an opera composed by Christian Bach at Manheim in 1770, when the celebrated air "Non so donde viene" was in his part, and which was afterwards sung on our opera stage with such effect by Ciprandi. Raff was at Paris more than once; for in 1780, his 70th year, Laborde speaks of him with great respect. "This celebrated tenor has acquired great reputation, and though at present d'un certain age, he obliges us still to admire his taste, and regret all that he has lost." According to Gerber, Musical Lexicon, vol. ii. he sung at Manheim in 1783, and was living in 1792.

RAAGOE, in *Geography*, a small island of Denmark, near the N. coast of the island of Laland. N. lat. $54^{\circ} 58'$. E. long. $11^{\circ} 19'$.

RAAJAGUR, a town of Hindoostan, in the country of Malwa, near the river Nienuoudge; 74 miles N.E. of Ougein. N. lat. $24^{\circ} 2'$. E. long. $76^{\circ} 56'$.

RAALBRANN, a town of Austria; seven miles S.E. of Meissau.

RAAN, a town of Austria; four miles E.S.E. of Hooren.

RAASAY, an island of the Hebrides, or Western Islands, Scotland, is situated between the main land and the Isle of Skye, and is included within the parish of Portree and

shire of Inverness. It is about fifteen miles in length, and from two to five in breadth. On all sides the coast rises to a great height above the level of the sea; and on the east side its ascent is peculiarly bold, and almost perpendicular. The interior is throughout its whole extent mountainous; and hence is better adapted for pasturage than for tillage, but there are nevertheless several spots of very fertile and well cultivated land. The supply of free-stone is almost inexhaustible, and there is likewise plenty of lime-stone. Formerly there were in Raafay several ancient chapels, but these are now ruinous and only used as places of burial. Here are likewise remains of two forts, the highest of which was situated at the southern extremity of the island, and is called Dunn-Cann, as tradition records, from Canne, cousin to one of the ancient kings of Denmark. The other fort, called Castle-Broichin, is a well-known land-mark among sailors. The rock on which it is situated is nearly round, covering an area of little more than seventy feet square; is forty feet high, except at the spot where the stair leads up to it; and is sixty feet above the level of the sea at its base. The castle is built of stone and lime, and seems to have been no less strongly fortified by art than by nature. It was anciently the chief seat of the lairds of Raafay. Now, however, the family residence is at Clachan, or Kirk-town, near the opposite extremity of the island. One of the old Highland alliances has continued for more than two hundred years, and is still subsisting between Macleod of Raafay, and Macdonald of Skye, in consequence of which the survivor always inherits the arms of the deceased; a natural memorial of military friendship. At the death of the late sir James Macdonald, his sword was delivered to James Macleod, esq. the present laird of Raafay. Dr. Johnson, in his Tour to the Hebrides, speaks in warm terms of the elegance and hospitality with which he was entertained by this truly respectable family. Carlisle's Topographical Dictionary of Scotland, 2 vols. 4to. 1813. Pennant's Tour through Scotland, vol. ii.

RAASS, a town of the duchy of Stiria; five miles W. of Marburg.

RAASTORF, a town of Austria; four miles N. of Entzerstorff.

RAAT, a town of Hindoostan, in the country of Agra; 128 miles S.S.E. of Agra. N. lat. $25^{\circ} 37'$. E. long. $79^{\circ} 58'$.

RABACAL, a town of Portugal, in the province of Beira; 12 miles S. of Coimbra.

RABANUS, MAURUS MAGNENTIVS, in *Biography*, a celebrated German prelate in the ninth century, was born at Fulda in the year 785. He was educated partly at Fulda, and partly at Tours, under the famous Alcuin. In the latter situation he distinguished himself by an unwearied application to his studies, and his almost unequalled proficiency in all the learning of the times, both profane and sacred. Not long before the death of Alcuin he returned to Fulda, and embraced the religious profession in its abbey. In the year 810 he was placed at the head of a school belonging to the abbot Ratgarius, and the fame of his superior learning soon raised the seminary into great reputation, and filled it with pupils, many of whom were afterwards promoted to the highest ecclesiastical dignities, and proved the brightest ornaments of the age. In 815 he was ordained priest, and in 822 he was elected abbot of Fulda. About 830 he was, by his prudence and good conduct, the means of effecting a reconciliation between the emperor Lewis le Debonnaire and his sons. Shortly after this, Ebbo, archbishop of Rheims, who had been condemned for high treason, was committed to his custody. In 838, at the request of

of count Erlafrid, he sent a colony of monks from Fulda, to occupy a monastery lately founded by him at Hirschau; and at the same time, in order that he might be enabled to pursue his studies with less interruption, he devolved upon another person the care of governing the abbey. In the following year the monks expelled him from his post, complaining, that in consequence of his devoting himself to his studies, the necessary affairs of the monastery were neglected, and its estates suffered to be much dilapidated. He now retired either to St. Peter's Mount, or, as others report, to an humble apartment in the outer court of the abbey, where he spent his time in devotion, the study of sacred literature, and the composition of his various writings, deaf to the repeated entreaties of the monks who exhorted him to resume his authority. In 847 he was elected to the archbishopric of Mentz, and in the following year he summoned a council, in which he procured the condemnation of Godeschale, for maintaining the doctrine of St. Augustine respecting predestination and grace. Rabanus died in 856, at the age of 71. He is described by Dupin as "having excelled all his contemporaries in the learning of those times, in explaining the principles of the liberal arts and sciences, and the rules of grammar and rhetoric; in a readiness in collecting from the fathers of the church common places upon the sacred scriptures; in allegorizing the historical parts of the bible; in an exposition of the mystical reasons of the ceremonies; in a facility at turning prose into verse, and in the manner of reducing all common places in precepts and instructions." And Mosheim says "he is deservedly placed at the head of the Latin writers of this age; the force of his genius, the extent of his knowledge, and the multitude of productions that flowed from his pen, entitle him to this distinguished rank, and render improper all comparison between him and his contemporaries." He was denominated the great light of Germany and France, because from his fund of knowledge those nations derived principally their religious instructions. His writings were every where in the hands of the learned, and were held in so much veneration, that during four centuries, the most eminent Latin divines appealed to them as authority in religious matters. His writings consist of Commentaries on the Scriptures; Homilies on the Epistles and Gospels; Scripture Allegories, and a great many theological and literary pieces. Of which the most considerable number were collected and published at Cologne in 1627, in six vols. folio. Some other pieces of this author, not to be found in that collection, may be found in Baluze's "Miscellanea," among Father Sirmond's publications, and in the eighth vol. of the Collect. Concil. Mosheim. Dupin.

RABASTENS, in *Geography*, a town of France, in the department of the Upper Pyrenées, and chief place of a canton, in the district of Tarbes; 10 miles N.N.E. of Tarbes. The place contains 750, and the canton 7422 inhabitants, on a territory of 150 kilometres, in 25 communes.

RABASTENS, or *Rabasteins*, a town of France, in the department of the Tarn, and chief place of a canton, in the district of Gaillac; 21 miles S.S.W. of Alby. The place contains 6076, and the canton 8124 inhabitants, on a territory of 152½ kilometres, in five communes. The principal article of its trade is wine.

RABAT, a town of Africa, in the empire of Morocco, situated on the S. side of the river Sallee. Rabat had formerly, at intervals, a number of European factories; but the difficulty of navigating the river, the obstacles arising from the arbitrary power of the sovereign, and the disposition and prejudices of the Moors, have disgusted the Euro-

peans. Nevertheless, Rabat is the most proper place for trade of any upon this coast, both for its vicinity to Europe, and the quantity of wool, leather, and wax, which it is capable of furnishing. From its central situation in the empire, it is also better adapted for the conveying the commodities imported to every part of the country; but a despotic government acknowledges no principle but the convenience of the moment; it commands, judges, and executes, without considering either cause or consequence. At Rabat, near the mouth of the river, are the ruins of a castle, built in the twelfth century by Jacob Almanfor, but entirely destroyed by the late emperor. The walls, which still remain, are near two miles round, and fortified by square towers. They enclose the castle, the town of Rabat, and a large space of ground where J. Almanfor built beautiful palaces, and laid out delightful gardens, watered by plentiful streams, which he brought from the neighbouring spring. These walls, as well as the palace and the town, were built by Spanish slaves, whom he took prisoners in his first campaign. Within the same inclosure he also built a very large mosque, of which the ruins still remain. The roof was supported by 360 columns of rough marble. Near it was a handsome square tower, strongly built with cut stone, near 200 feet high, and called the tower of Hallan. From this tower may be had an extensive view over the sea, and ships may be discovered at a prodigious distance. This monument is in almost perfect preservation. There are some docks for building ships both at Sallee and Rabat; but the difficulty of navigating the channel, and the probability that the sand will continue to accumulate, give ground for apprehending, that very soon, only vessels with oars will be able to enter the river. Chenier's Morocco, vol. i.

RABAT *Affarmacan*, a town of Persia, in Farfistan; 120 miles E. of Schiras.

RABAT *Arwab*, a town of Persia, in the province of Kerman; 40 miles E. of Kelvah.

RABAT *el Cadi*, a town of Persia, in the province of Kerman; 40 miles E. of Maltih.

RABAT *Maabad*, a town of Persia, in the province of Kerman; 60 miles N. of Kabis.

RABAT *al Nassi*, a town of Persia, in the province of Kerman; 60 miles N.E. of Maltih.

RABAT *Shcharifan*, a town of Persia, in the province of Chorasan; 260 miles N.E. of Ispahan.

RABATE, in *Falconry*. A hawk is sometimes said to rabate, when, by the motion of the hand of the bearer, the lure, call, &c. the leaves pursuing her prey, or quarry, and recovers the fitt.

RABATE, in *Commerce*. See **REBATE**.

RABBA, in *Ancient Geography*, a town of Judea, which belonged to the tribe of Gad; situated upon the torrent of Jaba; it was besieged by Joab, after he had defeated the Ammonites. Here was seen the head of Og, king of Bashan, who alone remained of the race of giants.—Also, a town of Palestine, in the tribe of Judah. See **RAHABAH**.

RABBATH-AMMON, or **PHILADELPHIA**, a town of Asia, situated in the mountains of the southern part of Palestine; S.E. of Tiberias, and S. of Bosra.

RABBATH-MOAB, or **ARCOPOLIS**, a town of Asia, situated at some distance to the east of the lake into which the river Jordan discharges itself.

RABBEN, in *Geography*, a small island in the gulf of Bothnia. N. lat. 63° 14'. E. long. 22° 14'.

RABBET, in *Carpentry*, is a deep groove or channel, cut in a piece of timber longitudinally, to receive the edge of a plank, or the ends of a number of planks, which are to be securely fastened in it. The depth of this channel

is equal to the thickness of the plank, so that when the end of the latter is let into the rabbet, it will be level with the outside of the piece. Thus, in ship-carpentry, the ends of the lower planks of a ship's bottom terminate upon the stem afore, and the stern-port abaft, with whose sides their surfaces are even. The surface of the garboard streak, whose edge is let into the keel, is, in the same manner, level with the side of the keel at the extremities of the vessel.

RABBIT-Plane. See **PLANE**.

RABBETING, the planing or cutting of channels, or grooves, in boards.

RABBI, or **RABBIN**, a doctor of the Jewish law.

The word in its original, **רַבִּי**, signifies *master*.

The words *rabbi* and *rabbin* have the same signification; yet is there some difference in their use. When we speak absolutely, and without applying the term to any proper name, we say *rabbin*, not *rabbi*. Thus we say, it would be unjust to attribute to the ancient rabbins all the notions of the modern ones.

On the other hand, when we prefix the term to the proper name of some Jewish doctor, we say *rabbi*, not *rabbin*; *rabbi* Salomon Jarchi is of this opinion.

Yet *rabbi* having no plural, we say, the rabbins Juda Ching, and Juda ben Chabin, are the authors of two ancient Hebrew grammars.

The title *rabbi* is said to have been first assumed, as a distinguishing title of honour, by men of learning, about the time of the birth of Christ; though it had been anciently given to several magistrates and officers of state, and to those who were of superior rank and condition in life. See *Esther*, i. 8. *Jer.* xli. 1. *Job*, xxxii. 9.

The first Jewish *rabbi* said to have been distinguished with any title of honour, was Simeon, the son of Hillel, who succeeded his father as president of the sanhedrim; and his title was that of *rabban*. The later rabbins tell us, that this title was conferred with much ceremony. When a person had gone through the schools, and was thought worthy of this degree, he was placed in a chair raised above the company; and then were delivered to him a key and a table-book; the key as a symbol of the authority conferred on him to communicate the knowledge he had acquired, which key he wore as a badge of honour, and when he died, it was buried with him; and the table-book was a symbol of his diligence in his studies, and desire of farther improvement. To these ceremonies were added the imposition of hands by the delegates of the sanhedrim, and the proclamation of his title. It has been disputed, chiefly between Vitringa and Selden, whether our Lord had taken the degree and title of *rabbi* in the Jewish schools; Vitringa maintains the affirmative, and Selden the negative. See *Jennings's Jewish Ant.* vol. i. p. 400, &c.

The Jewish writers distinguish betwixt the titles *rab*, *rabbi*, and *rabban*.

In the Old Testament we find the term **רַב**, *rab*, in composition with some other words, employed as a name of office and dignity, but not till the people became acquainted with the Chaldeans, concerning whom only it is used. The word, both in Hebrew and in Chaldee, signifies sometimes *great*, sometimes *many*, and when used substantively, denotes one who is at the head of any business, of whatever kind it be. Thus **רַב הַחֶבֶל**, *rab hachebel*, is, in the LXX, *πρωτεύων*, *great*, sometimes *many*, and when used substantively, denotes one who is at the head of any business, of whatever kind it be. Thus **רַב טְבָחִים**, *rab tebachim*, *αρχιμαγειρος*, *chief cook*. (*Jonah*, i. 6. *Jer.* xxxix. 11, see also *Dan.* i. 3.) It is used in the plural also for *chief men* in general, superintendents, or those at the head of affairs. Thus **רַבֵּי הַמֶּלֶךְ**, *rabbi hammulech*, are

the chief men employed by the king over the different departments of the state. (*Jer.* xxxix. 13.) The original term suits entirely the import of the Latin word *princeps*, but not of the English word *prince*, at least in its most common acceptation; for they are not the king's sons, or nobles of any order, who are so denominated among the Chaldeans. The word evidently appears to have been equivalent to the term **רֹשֶׁה**, *shar*, among the Hebrews. Accordingly, he who is styled by Daniel, in the above cited passage, **סַרְסִיס**, *rab serisim*, is four times, in the same chapter, called **רֹשֶׁה הַסַּרְסִיסִים**, *shar baserisim*. (*Dan.* i. 7, 8, 9. 18.) And this use of the name *rab* seems to have continued long in Syria, as well as in Chaldea. Thus in the Syriac New Testament, it is found in the same manner, united with the common appellation of any sort of officer, in order to denote the principal person in that office: thus, *rab-cohana*, (*Matt.* xxvi. 51.) is the high priest, *rab-machsa* (*Luke*, xix. 2.) is chief of the publicans, and *rab-raghotha* (*1 Pet.* v. 4.) is chief shepherd. *Rab*, construed in this manner, is equivalent to the Greek *αρχι*, as used in composition. The preceding titles are accordingly thus expressed in Greek, *αρχιεπισκοπος*, *αρχιεπισκοπος*, and *αρχιεπισκοπος*.

Again, the word *rab* is sometimes found in that version, combined not with the title of any sort of officer, but with a term denoting the office or charge itself; in which case it always means the person who is principally entrusted with the business. Thus, *rabbeth* (*Matt.* xx. 8.) is the steward, *παιδοπολος*, he who is over the household; and *rab-congheetha* (*Mark.* v. 35.) is the ruler of the synagogue, *αρχισυναγωγος*. It is not unlikely, though no example occurs in scripture, that the term has at first been similarly compounded with some word signifying a school, or, perhaps, with the name of the art or science taught, in order to denote the overseer of such a seminary, or the teacher of such an art. When the term *rab* came to be peculiarly applied, as an honourable compellation of the learned, the word with which it was, at first, for distinction's sake, compounded, would be superseded as unnecessary. It is, at least, certain, that the Jewish doctors, who resided at Babylon about the time of our Saviour, were called simply *rab*. But in the Old Testament there is no trace of such a title as *rab*, *rabbi*, or *rabban*, given to a man of letters; nor is any one of the old prophets, or scribes, or indeed any other person, distinguished by this mark of respect prefixed to his name. Although the introduction of titles is always occasioned by the erection of useful important offices, it is commonly in the decline of merit that pompous titles are most affected. At first, without doubt, vain-glory has led many to assume them, to whom they did not belong, in right of office, and an interested adulation has induced others to give them. Some of them, however, came soon, among the Jews, to be converted into a kind of academical distinctions, which, in order to give them more weight, are said to have been conferred solemnly in their schools or colleges, accompanied with certain religious ceremonies. From this practice sprung literary degrees in Christian universities, to which there is nothing similar in all Pagan antiquity, either Greek or Roman, but to which the Jewish custom above-mentioned bears an evident and close analogy.

As for *rab* and *rabbi*, the only difference, it hath been said, betwixt them is, that *rab* was the title of such as had had their education, and taken their degree in some foreign school, *e. gr.* at Babylon; whereas *rabbi* was the title of such as were educated in the land of Judea, and more honourable than the other. But the highest and most honourable title was *rabban*; which, they say, was never conferred on more than seven persons; *viz.* on R. Simeon, five of his

his descendants, and R. Jochanan, who was of a different family.

Those who belonged to the Jewish schools were divided into three classes or orders. The lowest was that of the disciples or learners; the second, that of the fellows, or companions, who, having made considerable progress in learning, were occasionally employed by the masters in teaching the young students: and the highest was that of the preceptors, or teachers, to whom they appropriated the respectful title of *doctor*, or *rabbi*, differing, as some have said, from *rab* only by the addition of the affix pronoun of the first person. This title *rabbi* was the highest academical honour. In the gospels, *διδασκαλος*; is given as the Greek translation of the Syriac *rabbi*. (John, i. 38.) Yet this word does not, as the Greek, literally signify *teacher*; but, having been conferred at first, as a mark of respect on actual teachers, and afterwards on other learned men, was justly accounted as apposite a version as the Greek language afforded.

In process of time, the term *rabbi* was used with great latitude; being bestowed on those who were not actual teachers; and yet it always retained, ever since it had been appropriated to the learned, a relation to learning, and denoted that the person who enjoyed it, though not actually employed in teaching, was well qualified for the office. *Rabban*, as some have asserted, is not the name of a degree superior to *rabbi*, though it seems intended for heightening the signification, and may be understood to denote eminent or learned *rabbi*, but it was very seldom used. The title *rabbani*, which we find to have been twice given to our Lord, (Mark, x. 51. John, xx. 16.) is *rabban*, with the addition of the affix of the first person, and accommodated to the pronunciation of Judea. The use of the term *rabban* does not seem to have extended far beyond Palestine, as we may conclude from the following circumstance. Although the word *rabbi* is very common in the Syriac translation, the Greek *διδασκαλος* being generally so rendered; yet in the only place where that translator introduces the word *rabbani*, which is that quoted from John, he prefixes in *Hebrew*, that is, in the dialect of Palestine, which was then so called, adding the explanation given by the evangelist, *that is, teacher*; which plainly shews that the word *rabbani* was not Syriac. This is the more remarkable, as in the other passage, where the historian interprets, in the same manner, the word *rabbi*, adding (John, i. 38) “ὁ λεγόμενος ἱεροκλεὺς διδάσκαλος,” that interpreter omits this explanatory clause as intended only for the Grecian reader, and of no use to those who understood Syriac. In the passage in Mark, where *rabbani* occurs, as the evangelist had added no explanation, his interpreter has not thought it necessary to change their own word *rabbi*; thus regarding the difference in signification between the two words as inconsiderable, to which we may add, that the apostle John explains both by the same Greek word. It may be here observed that it was customary to enhance the import of a title by doubling it. Thus our Lord, speaking of the Pharisees, says, (Matt. xxiii. 7.) “they love to be called of men, *rabbi, rabbi*.” In this manner he was himself addressed by Judas, at the time when that disciple chose to assume the appearance of more than ordinary regard. (Mark, xiv. 45.) The title *υἱε* seems to have been used in the same manner. (Matt. vii. 21.) The words Jewish *rabbies* and Jewish *doctors* were commonly used synonymously. In Justin Martyr’s dialogue with Trypho the Jew, the rabbies are always called *διδασκαλοι*. But some may object that this does not account for the application of the title to our Lord. As he did not derive his doctrine from any of those learned seminaries, frequented by such of the youth as were reckoned

the flower of the nation, the name *doctor* could not, with propriety, be applied to him. To this objection it may be replied, that as in Judea at that time they spoke not Greek, but a dialect of Chaldee, not differing considerably from what is called Syriac, it is evident that the actual compellation by which our Saviour was addressed, was *rabbi*, equivalent to the Greek *διδασκαλος*. Besides, though the title *rabbi* could regularly be conferred only by those who had the superintendency of their schools, yet the people would be disposed to give the compellation through courtesy, and on the presumption that it had been conferred, wherever they saw or supposed distinguished abilities in teaching; and this probably was the reason why it was given to John the Baptist. (John, iii. 26.) Moreover, in the Jewish state, a divine commission was conceived to confer all sorts of dignities and honours, in an eminent manner, and thus superseded all ordinary rules and human destinations. Accordingly, some of those who gave the title of *rabbi* to our Saviour, were willing, either sincerely or pretendedly, thus to account for their doing so. Thus Nicodemus assigns the reason why he saluted him *rabbi* (John, iii. 1. &c.), although he knew that he had not been educated in human literature, and had not received from man any literary honours. Upon the whole we may remark, that the term *διδασκαλος* may be fitly expressed, either by the English term *doctor*, or by the Syriac *rabbi*, which is now so much naturalized among us, that its meaning, as a Jewish title of literary honour, can hardly be mistaken. It must also be allowed, that the *rabbi* among the Jews of our Saviour’s age, was a title in the highest degree respectful; and on that account it was interdicted by their master, even to the apostles themselves. Campbell’s Seventh Preliminary Dissertation.

The modern rabbins are entitled to a considerable respect among the Jews: they have the first places in the synagogues; they determine all matters and controversies of religion, and very frequently pronounce upon civil affairs. They have even a power to excommunicate the disobedient.

They retain a vast number of superstitious traditions, from the writings of their predecessors; which they observe as scrupulously as they do the law of Moses.

The ancient rabbins were infinite dealers in allegories. Their writings are almost wholly allegorical, particularly their comments and interpretations of the scripture.

They had a great number of rules, and forms of interpreting and quoting, which some modern writers suppose to have been followed by the apostles, in their interpretation and quotation of the prophecies of the Old Testament, in the New. See QUOTATION.

RABBINICAL Character. See HEBREW.

RABBINICAL Hebrew. See HEBREW.

RABBINIST, a follower of the doctrine of the rabbins; a term used in contradistinction to Caraites.

Father Simon contends for *Rabbanist*, or *Rabbanite*, instead of *Rabbinist*: in effect, the former readings are apparently preferable to the latter; the word being derived from the Hebrew *Rabbanim*, which is the name of the sect, and which the Jews use to distinguish their doctors from those of the Caraites.

Rabbinist, then, signifies a Jewish doctor who adheres to the traditions of his fathers; not simply a rabbin or doctor; for the Caraites, who oppose those traditions, have their rabbins as well as the other Jews.

RABBIT, CUNICULUS, in Zoology, a well-known animal of the hare kind, or the *lepus cuniculus* of Linnaeus, with a short tail and naked ears. In the wild state the colour of the fur is brown; but in a tame state it varies to a black,

pied,

RABBIT.

pied, and quite white; the eyes are of a fine red. In their wild state they inhabit the temperate and hot parts of Europe, and the hottest parts of Asia and Africa. *See *LEPUS Cuniculus*.

The female, or doe rabbit, goes with young thirty days, and then she kindles; and if she take not buck presently she loses her month, or at least a fortnight, and often kills her young and eats them.

In England they begin to breed at a year old, but in some places much sooner; and they continue breeding very fast from the time when they begin, four, five, six, or seven times a year being common with them. They have usually from four to eight in a litter, and hence it is that a small number at first will soon stock a whole warren, if left to breed a little while undisturbed. The does cannot suckle their young till they have been at buck again; this therefore is to be done presently, else there is a fortnight lost of the time for the next brood, and the present brood also probably lost. When the buck goes to the doe, he always first beats and stamps very hard with his feet, and when he has copulated with her, he falls backwards, and lies, as it were, in a trance; in this state it is easy to take him, but he soon recovers from it.

The buck-rabbits, like our boar-cats, will kill the young ones, if they can get at them; and the does in the warrens prevent this, by covering their flocks, or nests, with gravel or earth, which they close so artificially up with the hinder part of their bodies, that it is hard to find them out. They never suckle the young ones at any other time than early in the morning, and late at night; and always, for eight or ten days, close up the hole at the mouth of the nest, in this careful manner, when they go out. After this they begin to leave a small opening, which they increase by degrees, till at length, when they are about three weeks old, the mouth of the hole is left wholly open, that they may go out; for they are at that time grown big enough to take care of themselves, and to feed on grafs.

People who keep rabbits tame for profit, breed them in hutches; but these must be kept very neat and clean, else they will be always subject to diseases. Care must be taken also to keep the bucks and does apart till the latter have just kindled; then they are to be turned to the bucks again, and to remain with them till they shun and run from them.

The general direction for the choosing of tame rabbits is, to pick the largest and fairest; but the breeder should remember, that the skins of the silver-haired ones sell better than any other. The food of the tame rabbits may be colewort and cabbage-leaves, carrots, parsneps, apple-rinds, green corn, and vetches, in the time of the year; also vine-leaves, grafs, fruits, oats, and oatmeal, milk-thistles, fow-thistles, and the like: but with these moist foods they must always have a proportionable quantity of the dry foods, as hay, bread, oats, bran, and the like, otherwise they will grow pot-bellied, and die. Bran and grains mixed together have been also found to be very good food. In winter they will eat hay, oats, and chaff; and these may be given three times a day: but when they eat green things, it must be observed, that they are not to drink at all, for it would throw them into a dropsy. At all other times, a very little drink serves their turn, but that must always be fresh. When any green herbs or grafs are cut for their food, care must be taken that there is no hemlock among it; for though they will eat this greedily among other things, when offered to them, yet it is sudden poison to them.

Rabbits are subject to two principal infirmities. First, the rot, which is caused by the giving them too large a quantity of greens, or from the giving them fresh gathered,

with the dew or rain hanging in drops upon them. It is excess of moisture that always causes this disease; the greens, therefore, are always to be given dry, and a sufficient quantity of hay, or other dry food, intermixed with them, to take up the abundant moisture of their juices. On this account, the very best food that can be given them is the shortest and sweetest hay that can be got, of which one load will serve two hundred couples a year; and out of this stock of two hundred, two hundred may be eat in the family, two hundred sold to the markets, and a sufficient number kept in case of accidents.

The other general disease of these creatures is a sort of madness: this may be known by their wallowing and tumbling about with their heels upwards, and hopping in an odd manner into their boxes. This distemper is supposed to be owing to the rankness of their feeding; and the general cure is the keeping them low, and giving them the prickly herb, called *tare-thistle*, to eat.

The general computation of males and females is, that one buck rabbit will serve for nine does; some allow ten to one buck: but those who go beyond this always suffer for it in their breed.

The wild rabbits are to be taken either by small cur dogs, or by spaniels bred up to the sport; and the places of hunting those who straggle from their burrows is under close hedges or bushes, or among corn-fields and fresh pastures. The owners use to course them with small greyhounds; and though they are seldom killed this way, yet they are driven back to their burrows, and are prevented from being a prey to others. The common method of taking them is by nets, called purse-nets, and ferrets. The ferret is sent into the hole to force them out, and the purse-net being spread over the hole, takes them as they come out. The ferret's mouth must be muffled, and then the rabbit gets no harm. For the more certain taking of them, it may not be improper to pitch up a hay-net or two, at a small distance from the burrows that are intended to be hunted: thus very few of the number that are attempted will escape. The method by the dog, called the lurcher and tumbler, is also a very good one.

Some, who have no ferrets, smother the rabbits out of their holes with burning brimstone and orpiment. This certainly brings them out into the nets, but then it is a very troublesome and offensive method, and is very detrimental to the place, as no rabbit will for a long time afterwards come near the burrows, which have been fumed with these stinking ingredients.

The testicle of a rabbit is a very good object for examining the structure of this part of generation in animals. The testicles of various animals are very variously composed, but all, in general, of vessels variously rolled and folded together; and even the human testicles are of the same sort, being composed solely of rolls of vessels, without any intermediate substance, only consisting of vessels and their liquors. Phil. Trans. N^o 52.

The skins of rabbits are a great article of commerce, numbers being exported to China: the fur is of great use in the hat-manufacture.

RABBIT, in *Agriculture*, is sometimes employed as farming stock. It is sufficiently evident, however, that this is a description of farming stock that can only be attended to with advantage under particular favourable circumstances of soil and situation.

Situations proper for Rabbits.—The practice of forming rabbit warrens, can only be beneficially introduced where the lands are not capable of affording crops of tolerable grain or grafs. The great uncertainty of this sort of husbandry

husbandry renders it much more advantageous for the farmer to depend upon such crops, than on it. In hilly tracts of land, where the plough cannot be introduced, and where the soil is of such a light sandy porous nature, as to afford little or no grass for the pasturage of sheep, or in rocky situations, this system of management may take place with profit to the farmer.

And it has been observed by the author of the Rural Economy of Norfolk, that this sort of animal is there confined to the heathlets, and the barren hills upon the coast. A level country is unfit for rabbit-warrens, but convenient for the plough; on the contrary, rabbits delight in the sides of sandy hills; which, where turn-wrist ploughs are not in use, are extremely inconvenient for tillage; and, when cultivated, are generally unproductive. For the rabbit, on level ground, finds it difficult to make its burrow; the excavated mould is all to be dragged upward to the surface; hence a piece of ground altogether level, can seldom be stocked successfully with rabbits; unless it be first laid up by art, at a great expence, into inequalities. While, on the contrary, against the side of a steep hill, the rabbit has no difficulty to encounter; the declivity affords him a ready vent for his mould; his work is all down hill; and, unless the soil be too stubborn, or too rocky, for the rabbits to work freely among, a broken hilly country may generally be stocked with advantage; provided a tolerable market for the carcasses can be had within reach. He thinks there are, perhaps, few sandy or other loose-soiled hills, which would not pay better in rabbit-warrens, than under any other course of husbandry that could be introduced on them. And it is afterwards stated, in a minute, that on a considerable part of a farm which lies towards the coast, being hilly and very badly soiled,—more especially the tops and sides of the hills, which have always been full of rabbits in spite of all endeavours to destroy them,—the tenants last year (1782) applied for leave to convert this part, about ninety acres, into a rabbit-warren. Leave was given, and an allowance made them of half the estimated expence of raising a fod-wall fence round these ninety acres. He adds, that the fence was nearly finished, and the warren had, that year, turned out beyond expectation; it was valued by one who ought to be the best judge of its worth, at forty pounds a year; which is nine shillings an acre. And that, as the part of a farm, these ninety acres were not worth five shillings an acre; at the then present price of barley, they were not worth more than four shillings an acre. It is, therefore, observed, that for ten pounds a real improvement of twenty pounds a-year has been made and secured; for the warrener will, through necessity, hereafter keep the fence in repair for his own advantage. He remarks, that the fence is made about four feet high, and three feet thick; faced with greenward; and capped with furze, so as to project eight or ten inches over the face. Some of it was done for a shilling a rod; but the spring putting in, fourteen or fifteen pence a rod of seven yards was obliged to be given. And a neighbouring warrener, that winter, gave ninepence for the wall without the capping; which he does not mean to put on till the wall be thoroughly settled. This is very judicious; as several rods of that above-mentioned shot down in different places, as is often the case in such sort of work. It is further observed, that there are several patches in the vallies, and some on the tops of the hills which have usually been tilled. Some of these were last year (1781), and some of them ought to be every year, cultivated for the rabbits; thus, when the grass gets foul or mossy it should be ploughed up; fallowed, sowing turnip-feed for present feed, (they will not let rape get up,) and to prepare the soil for barley

and grass-feed the ensuing year. Thus a regular succession of feedage might be kept up for the use of these animals. And in the Rural Economy of Yorkshire it is stated, that at Dalby there are two pretty large warrens. At Lockton there is one now (the time of writing) planting. And there are other parts of these heights which might be profitably stocked with rabbits. In general, however, property is too much intermixed to admit of an improvement, which is singularly adapted to the nature of these high grounds. And, that in situations where the ground, as well as the soil, is suitable to rabbit-warrens, and where an extent of it, sufficiently large, can be collected together in one property, there is a very strong reason why it may be profitably stocked with rabbits. It is added, that one of the warrens of this district contains eighteen hundred acres of surface; most of it covered with a black moreland soil; part of it a barren gravel; some little of it a thin lime-stone loam; not worth perhaps, on a par, for the common purposes of husbandry, a shilling an acre; nevertheless, these eighteen hundred acres are let, as a rabbit-warren, for three hundred pounds a-year! He will not pretend to say, that this warren is worth three hundred pounds a-year, nor assert that it is not worth a shilling an acre to a husbandman. If it be worth two hundred and fifty pounds, as a warren, and supposing it to be worth even two shillings an acre, as a farm, it still is sufficient evidence of the profitableness of rabbit-warrens, in proper situations.

And in speaking of the wolds, he observes, that the warrens are numerous, and some of them very extensive. Coldham warren is at present, he believes, the largest upon the wolds; and, probably, the most valuable warren in the island. The Coldham farm contains about nineteen hundred acres; and, speaking generally, it is all warren; not, however, wholly appropriated to rabbits, a flock of from six to eight hundred sheep being kept within the warren walls; principally, however, on one side of the warren, away from the burrowing grounds. And this appears to be a practice peculiar to the wolds of Yorkshire and Lincolnshire, whose hills likewise abound much with rabbit-warrens, and where better soil is appropriated to rabbit-warrens, than is perhaps in any other part of the island. The Coldham warren, in point of soil, is most of it worth from ten to twelve shillings an acre; some of it fifteen or sixteen shillings. But the present bleakness of the situation renders it of little more than half the value. As these better parts become mossy, they are inclosed by a fod-wall, the surface pared and burnt, and the soil broken up for arable crops. Having afforded a succession of crops of corn, turnips, &c. they are sown with grass-seeds, and again thrown open to the rabbits and sheep. In 1783, there were about two hundred acres of this farm under the plough, besides some little sheep-walk which lay without the warren walls. The warren therefore, at that time, contained from fifteen to sixteen hundred acres; and, adjoining to Coldham, are two more considerable warrens; so that there are, perhaps, three or four thousand acres of tolerably good land, lying together, and appropriated principally to rabbits.

But it is remarked in respect to soil, that there is a disadvantage in stocking a rich soil with rabbits; a flush of grass, after a dry season, is found to produce a scouring; which sometimes carries off great numbers. With regard to the burrows on the high wolds, they are mostly on the sides of hills; at Coldham, principally in one deep valley; whose sides are steep; giving the rabbits great freedom in working. The soil, in this case, is about eight or ten inches deep, under this a chalky rubble, of some inches thick, lying on a chalk-stone rock. The burrows are in the sub-soil.

between the soil and the rock, and chiefly towards the tops of the hills. And thousands of daws build their nests in the burrows, to the great annoyance of the rabbits. But at Driffeldgreets, near Driffeld, where there are two large warrens, the surface is a dead flat; nevertheless, the warrens are well stocked and productive; a proof that a flat surface may, in some cases, be profitably stocked with rabbits. The soil, in this case, is a light sand or gravelly loam, which is very proper for the purpose to which it is applied.

In some of the very southern districts, rabbits occupy the different sandy hillocks, and many of the rocky wastes; but there is nothing of any great importance in the management of them. Both the grey and black sorts prevail in some instances. The writer of the *Suffex Report on Agriculture* thinks, that this sort of stock is the nuisance of a county; it increases and flourishes in proportion to the size of the wastes, and is, of course, productive in this county. From Horsham forest, Ashdown, and other parts, very considerable quantities of rabbits are sent to be disposed of in London.

In some of the midland counties they are found to be sufficiently abundant upon the sandy parts of waste lands; in inclosed level land, it is thought that they are no better than vermin, and that should the commons be pretty generally inclosed, they must be in a great measure exterminated to make way for a better sort of stock; in inclosed land, they can only be kept with propriety, either in small warrens near the house, well fenced in, for family consumption; or on sandy or rocky precipices, impracticable to the plough, where they should also be fenced in. It is well known, that in the neighbourhood of commons abounding with them, great pains and expence are often used to fence the inclosed adjoining lands from their depredations. Rabbits are certainly a sort of stock unworthy of being cultivated, or bred in any considerable numbers, on inclosed and cultivated land; yet doubtless deserving considerable attention on impracticable sandy or rocky steeps, which may at the same time be planted; and when properly fenced in, and thus stocked, such land seems in a system of the highest improvement of which it is capable.

In Cheshire many doubts have been entertained as to the advantages of encouraging the breed of rabbits, and many farmers are so utterly averse to them, that they would wish the whole race to be entirely exterminated. Where land is inclosed, and applied to arable purposes, it seems agreed that by the injury they do to the fences, by the interfering with the cultivated land, and by the destroying of its produce, they are much more detrimental than profitable. It is, however, thought to be a question for consideration, whether, if a portion of weak sand, or dry heath land, was set apart for a rabbit-warren, well fenced, and kept distinct for this purpose; it might not, in some situations, be more profitably employed in this than in any other manner.

By some it is supposed, that it may be occasionally necessary to restrain them, on account of their astonishing fecundity; but that to attempt to exterminate them, if it were possible, could not be politic or adviseable, as they furnish food for foxes, which would otherwise prey on game and poultry:

This sort of stock is frequently met with in many other districts on tracts and spots of similar kinds of barren and uncultivable sorts of land, and is probably the most convenient, appropriate, and beneficial description of any by which they can possibly be occupied and managed.

Stocking.—In the second of the above districts, it is stated, that in stocking a warren, whether the surface be flat or hilly, artificial burrows are made, to reconcile the rabbits

to the ground, and to preserve them from vermin, until they have time to make their own burrows. And that in making these burrows, an improvement has lately, it is observed, been hit upon. They are bored with an auger, of a diameter large enough to make a burrow of a sufficient width. In a level warren, these augers may, from time to time, be found useful in forming such holes. They, however, in most cases, are capable of making burrows for themselves without any difficulty.

But in regard to stocking in Lincolnshire, according to the agricultural survey of that district, some of the warren lands are stocked in the proportion of three couple only to the acre; while in others, it is in a considerably larger proportion. And one buck or male rabbit is said to be there sufficient for one hundred does, or females; but this is certainly a much larger proportion of the latter sort, than is allowed in most other districts. On the wild warrens of Yorkshire, according to Mr. Marshall, one male is considered as sufficient for only *six* or *seven* females, and the nearer they can be brought to that proportion, the greater the stock of young ones that may be expected, it being the nature or economy of the males to destroy their young, especially when the proportional number is too great.

Fencing.—The fencing in these situations is sod-wall, capped with furze, or of late with stiff straw, forming a kind of thatch. And it is supposed, that reed would be found admirable in this intention. The warrens near Driffeld are fenced with paling; an expensive fence in the outset, and always under repairs. A brook, though ever so deep, is found to be insufficient as a fence against rabbits; one side of Driffeldgreets warren is bounded by a brook; but it is nevertheless fenced with paling. When the rabbits can evade this, they readily swim the brook. The necessity of good fences is of course sufficiently evident in this view, as well as that of preserving them from the destruction of vermin, and birds of prey, such as eagles, kites, &c. which are taken in steel traps, placed on elevated mounds of earth, where they delight to sit. It is this kind of fencing and coping, or kidding the top, together with food in winter, nets, traps, and other things for taking them, with charcoal for drying the skins, warreners' men for killing and carrying, horses for carrying them to market, &c. that constitute the great expence of this sort of management.

Different Breeds.—There are many different breeds or varieties of these animals, but those that are employed as stock for warrens are the common grey and silver-grey breeds: the former of which is found to be considerably more hardy and much better for the purposes of food; but the latter has greatly the advantage in the value of the skin. In the above warrens, till lately the common grey rabbit, probably the native wild rabbit of the island, was the only species. At present, the silver-haired rabbit is sought after, and has, within the few last years, been introduced into most warrens. The skin of the grey rabbit is cut; that is, the wool is pared off the pelt, as a material of hats; whereas, that of the silver-haired rabbit is dressed as fur; which, the writer understands, goes principally to the East Indies. The colour is a black ground, thickly interspersed with single white hairs. The skins of this variety sell for about four shillings a dozen more than those of the common sort; a sufficient inducement for propagating it in preference to the grey sort in most cases. If the white sorts could be introduced they might be still more valuable.

Management, Expences, Profits, &c.—This is a sort of stock that on the whole only requires a slight attention; it is, however, necessary to supply the rabbits with additional food in the winter season, when the weather is severe, such

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such as fine green hay, fainfain, clover, turnips, and others of the same sort, which must be distributed over the warrens. It is supposed that turnips answer the best in deep snows, as the rabbits can discover them by the scent. This sort of food is given in the quantity of two or three large cartfuls to a thousand couple *per* day, and one load of hay in the same time during a storm. It is likewise sometimes the practice to distribute billets of new cut ash-boughs, gorse or whins, and other similar woods in the warrens, the bark and other parts of which is eaten, by which the proportion of hay is lessened in a considerable degree. In great snows, it is necessary to clear them away from the ditches or fences, to prevent the rabbits from getting over them.

It may be observed, that the rabbit is a sort of stock that begins to breed at an early age, as at eight, ten, or twelve months, going only about thirty days with young, the young being a little more than three weeks old before they appear from the burrows, during which time they are suckled twice in the day by the mother. It is therefore evident, that they may breed three or four times in the course of the year under good keep, as the does take buck almost immediately after producing their young. In warrens that are inclosed, it is however said, that they seldom breed more than two or three times in the year. The annual produce *per* acre, is mostly estimated at from three or four, to eight or ten couple, yielding a profit of from eight, ten, or even fifteen shillings, where they are conducted under a good system of management. And the produce is, as has been seen, the largest on new lands; however, much of the profit must always depend on situation, so as to be near good markets.

These animals are in what is termed season from the end of October to the beginning of January, in which period the best skins are produced: of course a large proportion of them is killed in this short time. The farmer often sustains great loss in what by the purchasers are called *half* skins, *quarter* skins, and *racks*, sixteen of which are only considered as a whole skin. The rabbits are disposed of by the hundred, six score couple being considered as an hundred.

The following statements are given in the Agricultural Survey of Lincolnshire, on this sort of management. On the authority of Mr. Chaplin, it is stated that on 1000 acres it is fair to kill 2000 couple, which are sold by the hundred, as above; which have sold at 10*l.* on an average of ten years; last year 13*l.*; killing and looking after, 60*l.* for 1000 acres. And on the warrens between Gayton and Tathwell, silver skins have been from 15*s.* even to 21*s.* a dozen; but the common grey rabbit is so much harder, that if a warren be stocked with both, there will, in a few years, be nothing but greys. It is added, that from Louth to Caistor, 18 miles, 10 of them are warrens, chiefly silvers; rent 2*s.* to 3*s.* an acre. They plough a part every year for corn and turnips; and laying down again with seeds, let down the fences for the rabbits to enter. Warrens are reckoned profitable, so that some fortunes have been made on them. It is further stated, that in point of skins, those bred about May-day undergo no change from their white colour, but from a white rack become a whole skin; bred at Lady-day, become black; in June, white; in July, black; in November, white again: then in full season, as the carcases are also. The skins ought to have those colours on the inside, when flayed, or stripped off from the rabbits. The writer further states, that from 250 acres of land, that were fainfain worn out, and planted with rabbits, the following was the account many years ago; but all prices, rent, &c. &c. are calculated at the present rates; and it is to be noted; that the ground being thus new to rabbits

was much more productive than old warren land is found to be, as they breed much better on such new than on old land. Used to kill about 2000 couple; stock left about 700 couple. Sod banks that coll, thirty-five years ago, 1*s.* 2*d.* a rood of seven yards, would now coll 2*s.*; furze faggots were 7*s.* a hundred, that is, 5*s.* for the furze, and 2*s.* kidding, now doubled. Banks will last about seven years, in a middling way; from three to twenty: want facing once in seven years, at half the first expence; want capping in three years with the furze. Laying on, or capping, 3*d.* a rood now. It was then reckoned that 250 acres would clear 100*l.*, besides rent, which then was 1*s.* an acre. Fencing annually half a mile 800 yards 133 roods at 1*s.*, 6*l.* 13*s.*; for facing furze, a kidd will do a yard; 2½ miles kidding, at a kidd a yard, 4400 yards and kidds, at 15*s.* now, for 120 or 27*l.* 10*s.*, or *per annum* 9*l.* 3*s.* 4*d.* add 6*l.* 13*s.*, it is 15*l.* 16*s.* 4*d.* *per annum*. A warrener 35*l.*, a cow, fuel, and house: in all 40*l.* Extra labour, killing 18*s.* a-week for sixteen weeks, 14*l.* 8*s.* Also for a month 18*s.* a-week, 3*l.* 12*s.*: in all 18*l.* Besides nets and thread, 12 at 60 yards each; last six or seven years; would coll 1*l.* 11*s.* 6*d.* Traps 5*s.* a-year. The men who kill will carry. Four horses for six weeks, 1*l.* 4*s.* a-week, 7*l.* 4*s.* Charcoal for drying skins, 5*s.* A person to order skins, that is, clear from fat, and drying, five weeks; a useful woman will do it, 1*l.* Winter food (after three days snow they must be served) cannot be less than 10*l.* a year on 250 acres.

Recapitulation.

	Per Acre.					
	£	s.	d.	£	s.	d.
Rent now	-	-	-	0	6	0
Tithe	-	-	-	0	0	0
Rates	-	-	-	0	1	0
Fencing	-	-	-	0	1	3
Warrener	-	-	-	0	3	2
Extra labour	-	-	-	0	1	6
Nets, traps, and charcoal	-	-	-	0	0	2
Horses	-	-	-	0	0	6½
Winter food	-	-	-	0	0	0
				0	13	7½

Poison, powder, and shot, and sundries; fox- skins 1 <i>s.</i> each	-	-	-	2	0	0
				184	11	10

Produce.

2000 couple at 9 <i>d.</i>	-	-	-	75	0	0
Skins 9 <i>d.</i> to 1 <i>s.</i> 3 <i>d.</i> ; average 1 <i>s.</i>	-	-	-	200	0	0
				275	0	0
Expences				184	11	10
Profit				90	8	2

But it is, notwithstanding this statement, suggested, that if he had a warren of his own, he would plough it up for corn, &c.; thinking tillage now more profitable than rabbits. And the author adds, that at Partney fair, meeting with Mr. Grant of Withgull, and discoursing with him upon warrens, he informed him that a common flock in winter was three couple *per* acre, and the produce five or six couple

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couple killed; that killing, carrying, &c. might amount to something more than 1s. an acre: the sort *silver frig*, which will not do well in other counties, where they have been tried. He has now 1000 acres of warren; and upon 1000 acres the stock is 2600 couple, and kill 5000 couple annually. New land is the most productive. On such a warren, the rabbits must have two loads of hay a day in a storm, or two or three large waggon loads a day of turnips. The warrener has 20*l.* a-year, and two cows; the killers 8*s.* or 9*s.* a-week, and board for ten weeks. Silver skins now are 10*s.* a dozen; have been 14*s.* to 15*s.* Fences 60 a-year; no crofs ones; no buildings. The immense occupation of Mr. Grant and his sons, being much the most considerable in the county, with the circumstance of making an ample fortune, made him desirous of seeing him. It is added, that 20 years ago, Driby had a warren of 12 or 1300 acres; and the rent of the farm including it, 300*l.* a-year, which rent has been doubled by ploughing. And Mr. Kershaw observed, that the community received next to nothing from warrens; which is probably the case, as has been seen above, where the land is capable of being managed under the plough, or the system of grafts.

And the calculation of Mr. Parkinson, of a warren of 700 acres under rabbits, in the same district, stands thus: rent 5*s.*; standing stock 2000 couple of silver hair, valued to the incoming tenant at 2*s.* 6*d.* a couple ten years ago, and demanding a capital of 1400*l.*; and carefully typed to

catch all extra bucks, so as to leave only one-fourth of the total number of bucks.

	£	s.	d.
Produce 3000 couples for sale, worth, on } an average of seven years past, 15 <i>l.</i> a } hundred - - - - - }	450	0	0
But as some are greys, the price 10 <i>l.</i> - - - - - }	300	0	0
	750	0	0

Take the average of the two, that is, silver hair of the Wolds, and greys of Lincoln Heath, it will be on a medium - - - } 375 0 0

Or about 10*s.* 10*d.* an acre. And add to these, 350 sheep, kept by a course of tillage; that is, ploughing up 50 acres annually for paring and burning for turnips; then spring corn and feeds, which feeds sheep-fed one year, and thrown open to the rabbits: the sheep at 2*d.* per week for 25 weeks, will amount to 72*l.* 10*s.* This is inferior to the common produce of sheep; but the rabbits will demand hay, &c. to the amount of the difference; and also a team of horses must be kept for the cultivation of 100 acres of land, and carrying the rabbits to market. Hence,

	£	s.	d.
The 50 acres of corn will be consumed by } the horses, and master's and warrener's } cows, &c. - - - - - }	447	10	0

Expences and Profits of a Rabbit Warren Farm.

Dr.	£	s.	d.	Per Contra Cr.	£	s.	d.
To rent 700 acres of land, 5 <i>s.</i> per acre - - - - -	175	0	0	By slaughter of 3000 couple of rabbits, 15 <i>l.</i>	450	0	0
To tithe, one-ninth - - - - -	19	8	10	By 300 fleeces of wool, 4 and 5 to tod, }			
To town charges - - - - -	21	17	4	about 65 tod, 20 <i>s.</i> per tod, viz. 200 }	65	0	0
To master and mistress's board } £ s. d.				ewes and 100 hogs - - - - - }			
and clothing - - - - - }	52	0	0	Sell about 80 he-hogs, from turnips, 24 <i>s.</i>	96	0	0
To four children, 10 <i>l.</i> per year - 40 0 0				And about 50 drape-ewes, 21 <i>s.</i> - - -	52	10	0
To four servants, 10 <i>l.</i> ditto, viz. }				By 50 acres barley, 3 qrs. per acre, }	£ 150		
three men and one maid - - - }	40	0	0	and oats - - - - - }			
To extra labourers, carpenters, }				Deduct seed and horse corn - - - 70			
and other workmen - - - }	30	0	0				
Total housekeeping - - - - -	162	0	0	Remains 80 quarters, at 21 <i>s.</i> - - -	84	0	0
To Husbandry.				By 20 beasts, to sell about five to graziers, }			
A warrener, with house, and two cows - - - - - }	26	0	0	8 <i>l.</i> per head - - - - - }	40	0	0
To three extra labourers, mowing corn and hay, repairing, fencing, assisting in killing rabbits, &c. - - - - - }	72	0	0	By swine, poultry, &c. - - - - -	20	0	0
To blacksmith's bill - - - - -	15	0	0	Profit in breeding foals - - - - -	20	0	0
Carpenter's ditto - - - - -	22	0	0				
Extra turnip-hoers and hay-makers in summer - - - }	20	0	0	Total - - - - -	827	10	0
				Expences - - - - -	533	6	2
	155	0	0	Net gain - - - - -	294	3	10
	533	6	2				

It is noticed, that as the family is maintained out of the farm, the interest of the capital of about 1400*l.* is not charged, because the interest would be only 70*l.* per year, when they are maintained out of the farm, with a profit of 294*l.* 3*s.* 10*d.*

It is stated by the writer of the above agricultural survey, that the warren of North Ormsby, occupied by the late Mr. Ansell, is supposed to be one of the best managed in the county. The rabbits chiefly consist of silver-greys; the land of the yearly value from 2*s.* 6*d.* to 8*s.*, and some little of it 10*s.* the statute acre. The occupier was of opinion, that lately his warren lands would have paid him

better, had they been applied to the purpose of growing corn, and grafts feeds for keeping sheep. The rabbit produce he supposed to be from 8*s.* to 10*s.*; in some particular years they have paid from 15*s.* to 21*s.* an acre; but to obtain any extraordinary profit, very great care must, he thinks, be taken in killing the many different kinds of vermin which depredate, and, without the utmost vigilance, will

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will quite depopulate the warrens. A considerable expence also attends the necessity there is for night-watchers, to protect them from the infinitely worse vermin, the poachers. With him the silver-grey skins have been sold from 8½*d.* to 15*d.* and 16*d.* per skin: the last two years they have only brought from 10*d.* to 11*d.* per skin; but to obtain even these prices, they must be what is called full seasoned, whole skins, and of the choicest colours, with respect to which the fashion varies very greatly. The carcases, of late years, have not averaged net into pocket more than 4*d.* per couple, after the expence of drying them, and by means of light diligence carts, having them carried to markets 30, and sometimes more than 60, miles to obtain even that sum. This inconvenience is occasioned partly by its being necessary to kill eight or ten parts of a year's slaughter in so short a time, as between the second week in November and Christmas, on account of their skins being then only in full prime, and as they are also very soon subject to become putrid, much more so than hares; and their being obliged to be packed close together, very greatly increases the mischief.

The estimate of the warren on the estate at Thoresway of 1700 acres, as given by the tenant Mr. Holdgate, with the silver fort of rabbits, is this:

	£	s.	d.
Labour, three regular warreners, with extra assistants at killing	85	0	0
Fences	42	10	0
Winter food	42	10	0
Nets, traps, &c. &c.	14	3	4
Delivery	21	5	0
Rent is said to be 7 <i>s.</i> an acre	595	0	0

The capital employed is that sum with the addition of stock paid for; suppose this as stated about three couple an acre at 2 <i>s.</i> 4 <i>d.</i>	800	8	4
	595	0	0

Interest on that sum one year at 5 per cent.

1395	8	4
69	15	5
1465	3	9

Annual Account.

	£	s.	d.
Expences as above	800	8	4
Interest	69	15	5
	870	3	9
Produce 10,000 couple, at 2 <i>s.</i> 4 <i>d.</i>	1166	13	4
Expences	870	3	9
Profit	296	9	7

Or about 22*l.* per cent. (the 5 per cent. included) on capital employed. This the writer observes is very great, reckoned on the capital, but small reckoned by rent, as it amounts to only half a rent. But suppose the gross produce of 1500, which he takes to be nearer the fact; then the account will stand thus:

	£	s.	d.
Produce	1500	0	0
Expences	870	3	9
Profit	629	16	3

or 45 per cent. on the capital.

But it is supposed that, in whatever way it is taken, it explains the reason of so many of these nuisances remaining. The investment of a small capital affords a profit or interest that nothing else will, and of course the proprietor will be sure never to convert them to better use. But, it is asked, what says the public interest? Here are only 200*l.* expences to 600*l.* rent, what is the population, the industry, the improvement! The landlord gets the lowest of rents, the tenant makes a good profit, they divide all, and the rest of the world is little or no better for them.

Rabbit-warrens are met with in most other districts of the kingdom, both towards the southern and northern parts of it; but more abundantly in those of the north. In the south they have in most places been got quit of from any tolerable sort of land which is capable of affording any other better kind of useful produce, but in some parts of the north they still occupy spaces of ground which are of a good quality, and which might be converted to better purposes with great advantage to the proprietors, as well as farmers. Warrens of this nature, in some cases, in both these situations, however, still continue to be well stocked, and in the latter, are in particular instances of pretty considerable extents.

In Cheshire, the principal rabbit-warrens are on Delamere forest, though on several of the heaths and sand-lands these animals are frequently met with, but not in such numbers together as to constitute warrens.

In the north riding of Yorkshire, also, a few rabbit-warrens are met with on the detached moors, as well as on the skirts of the higher moors; but they are not so extensive as to make them an object of much attention. The kind of rabbits here are mostly the common grey, with the exception of the stock on a warren at Nappa, in Wensleydale, of about one hundred and fifty or two hundred acres, which consists of silver-greys, and is the only warren which is known, in this district, to be entirely stocked with this sort: they are stated to have been brought some years since from a warren in the above noticed district of Lincolnshire, to which they had been originally introduced from Ireland. The skins of this kind of rabbits are supposed to be worth double those of the grey; they are not used for felts, as the last, but dressed as furs, and ultimately exported in that state for the China market, where they are worn by the principal people; an use which has been already noticed and considered in regard to the demand which it creates.

But in the northern parts of Lancashire, warrens of this kind are more frequent. At Rossall-hall, in the tract called the Fild, one of great extent has existed for a very great length of time; but the present proprietor, B. F. Hisketh, esq. has, with great propriety, lately reduced it very considerably, by taking two large fine farms from it, so that it now consists only of about a hundred acres of the most sandy barren part.

This warren formerly supplied a great number of rabbits for sale in the markets and hat manufactories of the neighbourhood, and of course became a source of profit to the owner, though the management was very imperfect. The farms taken from it will, however, become far more advantageous to him.

The stock here was formerly of the grey rabbit kind, and it is still the same on the warren which remains, which is however far from being sufficiently stocked.

There was formerly no sort of green food ever cultivated for this sort of stock; nor has it been yet attempted on the present warren, but the proprietor intends to have it done in an effectual manner. Nor have the rabbits ever been fed in the winter season with either hay, bark, or any other sort

of food; their being so near to the sea-coast perhaps renders it unnecessary.

The only mode of taking the rabbits here has hitherto been in nets, by what is termed *running* them by means of dogs.

At Heysham the Rev. Mr. Clarkson has a tract of coarse stony land above his house, of about twenty acres, which has a great number of grey rabbits in it, and is well suited for a rabbit-warren, as it is incapable of being converted to any better purpose on account of the severity of the west winds, and the effects of the sea-spray thrown up by them, as well as its rocky, winy nature.

The principal rabbit-warrens in this county are, however, those in the sandy tracts in the south and north ends of the isle of Walney, and in the neck of land from which it seems to have been separated. The rabbit-warren at the north end of this little island occupies a considerable space of ground of this barren sandy quality, as well as that at the southern point. The former is stocked wholly with rabbits of the grey kind, this sort being in most demand. There is much expence attending these warrens in many cases.

The expence of stocking in order to keep them up is sometimes very considerable. In this instance the farmer has upwards of two miles of dike fence composed of sod and stone to keep up and in repair, which costs from five to six shillings the rod of seven yards. The expence of a man constantly to look after the rabbits, and keep the dike fences in proper order and repair. That of the purchase of the traps or types, which cost 3*l.* a-piece, and eighteen are required; but they last long, and cost little in repairs.

The providing net and dogs, which is annually about 10*l.*

The charge of taking the rabbits to Ulverston, twice in the week, during ten weeks, which is 5*s.* each time.

The sale of rabbits is annually from one hundred and fifty couple upwards, at the rate of 2*s.* 6*d.* each couple. They are usually sold to Lyons of Preston, who takes the charge of them after they have been delivered at the above-named place.

Not any sort of dry or green food is ever given to the rabbits in this warren during the winter season; but there is not any snow, and very little frost taking place; in consequence of the situation being so surrounded by the sea.

The warren at the south end of the same little island is of similar extent, and exactly under the same sort of management; but it is said to be earlier, by a month at least, in the breeding of the rabbits, and the quality of their fur; which is supposed to arise from its being more fully exposed to the influence of the morning sun, in which the rabbit delights, and by which it is greatly benefited.

The rabbits are here likewise asserted to sell for a higher price, as 3*s.* the couple, than in the warren at the north end of it.

The rabbit-warren at Sand Scale is another farm of this sort in this neighbourhood, under similar regulations, but somewhat smaller than those in the isle of Walney; and there is a still smaller one attached to a farm at Roanhead, the property of Miles Sandyes, esq. of Graythwaite, which is conducted in much the same manner, and with the same results as in the above case.

It may be noticed that this sort of stock is mostly taken by nets or traps, set in the form of a fold between the places where they run, and those where they feed, the rabbits being hunted into them as they return from feeding. But the wold warreners, Mr. Marshall says, have three ways of catching their rabbits: with fold-nets, with spring-nets, and with "types;" a species of trap. The fold-nets are set about midnight, between the burrows and the feeding-

grounds; the rabbits being driven in with dogs, and kept inclosed in the fold until morning. But the spring-net, when used, is, he believes, generally laid round a hay-stack, or other place, where rabbits collect in numbers. It is added that the trap is a more modern invention. It consists of a large pit or cistern, formed within the ground, and covered in with a floor: or with one large falling door, having a small trap-door towards its centre, into which the rabbits are led by a narrow muce. And this trap, on its first introduction, was set molly by a hay-stack; hay being, at that time, the chief winter food of rabbits; or on the outside of the warren wall, where rabbits were observed to scratch much, in order to make their escape. Since the cultivation of turnips, as a winter food for this species of stock, has become a practice, the situation of the trap has been changed. Turnips being cultivated in an inclosure within the warren, a trap is placed within the wall of this inclosure. For a night or two, the muce is left open, and the trap kept covered (with a board or triangular rail), in order to give the rabbits the requisite haunt of the turnips: which having got, the trap is barred, and the required number taken. He adds, that in emptying the cistern, the rabbits are sorted; those which are fat, and in season, are slaughtered; those which are lean, or out of condition, are turned upon the turnips to improve. And that, at the close of the season, the bucks and the does are sorted, in a similar way; the bucks are slaughtered, the does turned loose to breed. Mr. Marshall also remarks, that great caution is requisite in the use of these traps. If too many rabbits be admitted at once, and the cistern be kept close covered only for a few hours, suffocating and inordinate heat takes place, and the carcasses, at least, are spoiled. Many thousand carcasses have been wasted through this means. The traps are therefore watched; and when the required number is caught, the muce is stopped, or the trap covered in a proper manner.

And it is observed, that some notion may be formed of the produce of the wold warrens, from the great numbers which are frequently slaughtered at once; five or six hundred couple having not unfrequently been slaughtered in one night; and, it is said, that when the two Driffield warrens lay together, there was once an instance of fifteen hundred couple being killed at one time.

There is often much inconvenience in this sort of stock, from their getting out of their inclosures, and destroying the young corn-crops, new sown grasses, young turnips, and the quick hedges as well as young plantations of apple-trees that may be in the neighbourhood. This forms a material objection to this sort of stock by the farmer.

Tame Rabbits.—In respect to breeding and rearing tame rabbits with the view of profit, those who are engaged in the business perform it in hutches, which must be kept very neat and clean, otherwise the rabbits will be subject to disease. Care must be taken also to keep the buck and does apart, till the latter have just kindled, then they are to be turned to the bucks again, and to remain with them till they shun and run from them.

And the general direction for the choosing of tame rabbits, is to pick the largest and sleekest: but the breeder should remember, that the skins of the silver-haired and white sorts sell better than any other. The food of the tame rabbits may be colewort and cabbage-leaves, carrots, parsnips, green corn, and vetches in the time of year; also parsley, grass, green leaves, milk, and sow-thistles, and other similar plants, but with these moist foods they must constantly have a proportionable quantity of dry food, as hay, bread, oats, bran, and other similar matters, otherwise they grow pot-bellied, and die. Bran and grain mixed together have been found

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to be very good food. In winter they eat hay, oats, and chaff, and these may be given them three times a day; but when they eat green things, it must be observed that they are not to drink at all, as it throws them into a dropfy. At all other times a very little drink serves, but it should always be fresh. When any green herbs or grafs are cut for their food, care must be taken that there is no hemlock among it, for, though they will eat this greedily among other things, when offered to them, it is a sudden poison to them. In this mode of breeding, one male to eight or ten females is sufficient.

It is remarked, that the author of the Treatise on Agriculture and Gardening, has bred these animals with much success and ornamental effect in a small artificial warren, in a lawn in the garden, made in the following manner. "Pare off the turf of a circle, about forty feet diameter, and lay it on the outside; then dig a ditch within this circle, the outside perpendicular, the inner sloping, and throw earth sufficient into the middle to form a little hill, two or three feet higher than the level of the lawn; the rest must be carried away. Then lay down the turf on the hill, and beat it well to settle. The ditch at bottom should be about three feet wide, and three and a half deep, with two or three drains at the bottom, covered with an iron grate, or a stone with holes, to carry off the haily rains, in order to keep the rabbits dry. In the outside bank should be six alcoves, the sides and top supported, either by boards or brick-work, to give the rabbits their dry food in; by their different situations, some will always be dry; six boxes, or old tea-chests, let into the bank, will do very well. If the ground be very light, the outside circle should have a wall built round it, or some stakes driven into the ground, and boards or hurdles nailed to them, within a foot of the bottom, to prevent the bank from falling in. The entrance must be either by a board to turn occasionally across the ditch, or by a ladder. The turf being settled, and the grafs beginning to grow, turn in the rabbits, and they will immediately go to work to make themselves burrows in the sides, and in the hill. By way of inducing them rather to build in the sides, to keep the turf the neater, make a score of holes about a foot deep, and they will finish them to their own mind; and if there be a brick-wall round it, it should be built on pillars, with an arch from each, to leave a vacancy for a burrow." But there is, he says, another way that may be practised, which is, "to dig the ditch only about two feet deep, which will yield about earth enough to make the hill; put some pales, about a foot high, on the outside, for that will be a sufficient height to keep the rabbits in. Feed them as other tame rabbits are fed; and in wet weather sprinkle saw-dust at the bottom, by which means the quantity of manure will be increased; once a week is often enough to take it away: the quantity will be surprising, nor will the smell be in the least offensive, even though it be quite close to the house. In a very large lawn, two or three of these hills, with the rabbits feeding on the tops, will not be unpleasing objects. If the bucks happen to be mischievous in killing the young ones, they must be chained in an alcove; or else have their liberty as in a warren. After a great snow they will want some assistance early next morning; because the ditch will be nearly filled, and perhaps the alcove, where the hay is, will be blocked up."

He adds, that "it is a great improvement to castrate the young bucks, and keep them till they are full grown, before you kill them; the flesh will be amazingly finer, whiter, and tenderer. But then it will be best to take them away, and keep them in another warren, lest they

should be too numerous, and disturb the breeding does; or else have a few hutches in the alcove to fatten them in."

It is suggested, that "as oil-cakes are found of great use in fattening cattle, it is probable they would be useful in fattening rabbits: and it is asserted, that some of the oil mixed with the pollard or buck-wheat, is cheaper than the cakes; but having never made the experiment, he cannot ascertain its superior advantages."

In this mode, attention should be had to the breeding those sorts of rabbits whose skins are in the greatest esteem with the furriers and hatters. These skins are generally of more value than the flesh, especially in the winter, against which time contrive to have the greatest quantity of these fattened bucks.

Profit.—It is remarked, in respect to profit in this way, that where does are kept in hutches, they are supposed to breed six times a-year, and only five young ones are left to each, which is thirty from each doe: but as these are in a more natural way, and the young ones difficult to be gotten at, let us suppose about thirty-six to be produced from each doe, reckoning only seven-pence for each; there is a guinea profit from each doe; as the additional value of the skins in winter, and the dung, will more than pay the expence of food and attendance on them. And it is quite necessary that those who keep many rabbits in this way, should cultivate some lucern, parley, and carrots, as no other vegetables are such proper food for them as these; they should also be fed upon some of the best upland pasture-hay; for if it be coarse, so far from eating, they will waste it. Lucern hay is very proper for them in these cases.

In some districts very considerable profits and advantages are derived from the breeding and keeping of white tame rabbits. The skins of this sort having lately been much employed in trimmings, have sold at a much higher price than those of the common kinds. Their dung is also found of very great utility in the cultivation of large farms.

Diseases.—When kept in this way, rabbits are subject to several diseases, as the *rot*, which is caused by the giving them too large a quantity of green food, or the giving it fresh gathered, with the dew or rain hanging in drops upon it, as it is over-moillure that always causes the disease; the green food should, therefore, always be given dry, and a sufficient quantity of hay, or other dry food, intermixed with it, to counteract the bad effects of it. And a sort of *madness* often seizes them: this may be known by their tumbling about; their heels upwards, and hopping in an odd manner into the boxes. This distemper is supposed to be owing to the rankness of their feeding: and the general cure is the keeping them low, and giving them the prickly herb called tare-thistle to eat as much as possible. They are also subject to a sort of scabby eruption, which is seldom removed. These should, however, be directly separated from the rest of the stock.

It is noticed that the profit in this mode of management cannot, however, be well ascertained, as much will depend on the care which is taken in the feeding, and other management.

Rabbit-Warren, the place where these animals breed and rear their young. The land for this purpose should be of a light sandy quality, and it is best to have a hilly situation, with a sunny exposure, being well inclosed by means of sod-walls, or paling-fences: any sort of waste, craggy, or rocky land, on which nothing else can be cultivated, answers very well for this purpose. See *RABBIT*.

RABBIT-Warren Farm, that sort which is chiefly managed under the rabbit system. These sorts of farms are now much less common than formerly, but in some instances, as has been seen, they afford the best and most advantageous means by which lands can be turned to any account in the way of cultivation. They, however, in most cases require no little capital, exertion, and attention, to manage them in the best and most profitable methods. See **RABBIT**.

RABBIT Manure, that which is collected from the dung of those animals, and which is said to be very valuable. See **MANURE**.

It is found beneficial in different modes of application, as by being intimately mixed and blended with the main particles of the soil or mould in arable lands, and by being sown by the hand, only over the surface of it, in the way of a top-dressing, when they are in a state of crop. When used in this last manner, it is likewise highly advantageous on most sorts of grass land; and in both these cases of top-dressing with it, there is a very quick and powerful state of vegetation produced in the crops, which can hardly be gained in any other way. See **QUICK Manure**, and **TOP-DRESSING**.

In Oxfordshire, Mr. Fane has raised a small building for keeping rabbits in lutches, for the sake of the manure; he is said to have some hundreds, and to meditate the erection of a second building for keeping double the number; the present quantity make a load of manure in the course of the week; and as two loads manure an acre, they are the means of fully dressing twenty-six acres annually: it is not conceived by him that they produce any other profit, nor is it necessary; for to be able to sell so much food at home, and pay attendance, the profit of manuring such a breadth of land, it is supposed, must be considerable. Three dozen of rabbits in the week are mostly sent to the London market during the season in which they can be used.

This is a sort of dung or manure, which has yet been but little subjected to chemical examination, consequently its real properties, or constituent principles, are very imperfectly known or understood; it would appear, however, from the effects which it produces, that it may be employed with the most advantage, when laid upon the land, in its more raw, crude, or fresh state, before it has undergone much decomposition by the process of fermentation or putrefaction. It has, perhaps, never yet been kept dry and reduced into a powdery condition, so as to be put in along with the seed, in the manner of rape-dust, though it seems probable that it would go farther, and be more beneficial, in some cases, if used in this way. See **DUNG**.

RABCHORCADO, in *Ornithology*, the name of an American bird, described by Nieremberg with many fabulous circumstances. All that seems certainly known is, that its tail is very remarkably forked.

RABDA, in *Geography*, a town of Arabia, in the province of Yemen; 30 miles N.W. of Sana.

RABDIUM, in *Ancient Geography*, *Tur-Rabdin*, a town of Asia, upon a mountain, at some distance from the Tigris, south of Tigranocerta, and east of Nisibis.

RABDOIDES. See **RHABDOIDES**.

RABDOLOGY. See **RHABDOLOGY**.

RABDOMANCY. See **RHABDOMANCY**.

RABEOIA, a name given by some to the roots of the flammula major.

RABELAIS, FRANCIS, in *Biography*, was born about the end of the fifteenth century at Chinon, in Touraine. At an early period he entered himself among the Cordeliers, and became well skilled in the learned languages, and the

literature of the age. He acquired a good share of popularity as a preacher; and what he gained by his sermons, he expended in the purchase of a small library. His private life was not so exemplary as his public discourses were edifying; and for some misconduct, which caused scandal in the monastery, he was imprisoned in his cloister. By his wit and facetiousness he obtained his liberation, with the pope's permission to quit his order, and remove to that of St. Benedict. Not being able, however, to bear any kind of restraint, he laid aside his religious habit, and, in 1530, went to Montpellier to study medicine. After some time he repaired to Lyons, where he printed a collection of pieces of Hippocrates and Galen. Here he likewise published several other works, among which were some of the books of his History of Pantagruel, which gave him so distinguished a place among burlesque writers. In 1535 he went to Paris, and waited on cardinal John du Bellay, to whom he had been known when they resided in the same convent; and he now made himself so agreeable to his old friend, that he was taken into his house in the several capacities of physician, reader, librarian, and steward. Du Bellay, in the following year, going out as ambassador to the court of Rome, took Rabelais with him, where his wit so much interested the pope and cardinals, that he very readily obtained a full absolution for the crime of apostasy. In 1537 he took his doctor's degree in physic at Montpellier; and returning to Paris soon after, his friend the cardinal presented him with a prebend in the chapter of St. Maur. He was afterwards made the curé of Meudon, which office he held from 1545 to his death, in 1553, being, according to one of his biographers, in the 63d, and according to another, in the 70th year of his age. His *Pantagruel*, which was finished about the time that he accepted the curé of Meudon, brought upon him the hostility of the monks, whom he had severely satirized, and who procured its condemnation by the Sorbonne and the parliament; but it caused his company to be much sought after, as the wittiest writer of his time. The want of decency was easily pardoned at that period, and Rabelais had some estimable qualities, and possessed extensive and various erudition, with a ready elocution, and an inexhaustible store of ludicrous ideas. "The *Pantagruel* and *Gargantua* of Rabelais," says a critic, "are to be regarded as comic satires, often concealing, under a whimsical extravagance, attacks upon follies which it would not have been safe seriously to expose. It is in vain, however, that commentators have attempted to find out the meaning in much that is mere ribaldry and nonsense, and even to discover real history veiled in the allegory of burlesque, where the author meant nothing more than to make his reader laugh or wonder. His satire, where it is intelligible, is often just and ingenious; but the obscurity of his language, and eccentricity of his conceptions, render the perusal of his works, to a modern at least, rather a task than an amusement." The most complete editions of his works is that published in Holland, in 5 vols. 8vo., 1715, with notes by Duchat; and that at Amsterdam, in 3 vols. 4to., 1741, with plates by Picart. The letters of Rabelais were published in an octavo volume, with notes by St. Marthe. The memory of Rabelais is perpetuated in the medical school of Montpellier, where bachelors are invested with a scarlet robe, said to have been the very robe which that wit himself wore.

RABELHORST, in *Geography*, a town of the duchy of Holstein; 5 miles W.N.W. of Cismar.

RABENAU, a town of Saxony, in the margraviate of Meissen;

Meissen; 8 miles S.S.W. of Dresden. N. lat. $50^{\circ} 52'$. E. long. $13^{\circ} 36'$.

RABENECK, a town of Bavaria, in the bishopric of Bamberg; 3 miles S.W. of Weischenfeld.

RABENER, THEOPHILUS WILLIAM, in *Biography*, a celebrated German writer, was the son of an advocate at Leipzig, and born at Wachau in 1714. He was educated at home, by tutors employed for the purpose; but when he was 14 years of age, he was sent to the college of Meissen, where he had for fellow-students Grabener, Gärtner, and Gellert, with whom, and particularly with the last, he formed a friendship which continued through life. In 1735 he went to the university of Leipzig, where he applied himself chiefly to the study of jurisprudence, without entirely neglecting the Muses. In 1741, professor Schwabe having begun a journal in the German language, entitled "Amusements of Reason and Wit," Rabener became one of his principal coadjutors, and continued to assist him by his contributions till the year 1744. He is chiefly known as a writer in the first volume, by a humorous piece entitled "Proofs of the Necessity of employing Rhyme in German Poetry." This periodical work was, for some time, carried on with spirit and success; but at length it became degraded by literary disputes, which finally put an end to it; and another was established, under the title of "Contributions of Bremen." The writers engaged in this were all the most celebrated persons who flourished at that period, among whom were Gärtner, Schmidt, and Rabener, to whom were united Gellert, Klopstock, and others. The Journal of Bremen forms an epoch in the history of the German literature, as it introduced into the country a better taste, and tended greatly to improve the language, which, previously to this, had been much neglected. Rabener had before this been appointed controller of the taxes in the circle of Leipzig, a place of great labour, and which required an exact knowledge of the laws of the country, and the most inflexible integrity. Notwithstanding, however, the attention which the duties of this office required, he found leisure to continue his literary pursuits; and towards the end of 1751, composed his satirical letters, in which he introduces persons of every state and character, all of whom speak in the language suited to their condition. In 1753 he was appointed chief secretary to the directors of the taxes at Dresden; and two years afterwards he published the fourth and last volume of his satires, which contains "A burlesque Explanation of the Proverbs of Sancho Panza," the "First of April," and "The Excuse and Reparation." After this he began to write for the stage, and composed a comedy in four acts, entitled "The Free-thinker," which, with many other papers and letters, were burnt, together with his house, during the siege of Dresden, in 1760. He now abandoned his literary labours, but his friends obtained from him a collection of letters, which were afterwards published by Weiss. These were never intended for the public, but they are written with so much truth and sincerity, and exhibit a more correct picture of the author than any pen could have drawn. His health began to decline soon after his loss in 1760, and in 1767 he experienced a paralytic stroke, which was repeated in 1769; but he lingered out till March 1771, when he died. "He was," says his biographer, "among the small number of those privileged men, whom nature has endowed with every quality necessary to their state. He thought and spoke in a manner peculiar to himself: his pleasantries flowed as from an abundant source; he never sought for them; and they appeared so natural, pleasant, and lively, that it was impossible not to be struck by them. But he displayed his

wit only among his friends: he never lavished it on the rich and great; on the contrary, he concealed it, when invited merely for the purpose of being heard. He always spoke the truth, without regard to persons or rank." Rabener, says he, was the favourite author of Germany, who wrote poetically in prose, whose satirical, sportive genius possessed salt without gall. Rabener's works are generally known throughout Europe, having been translated into the French, English, Dutch, and Swedish languages. Gen. Biog.

RABENSPURG, in *Geography*, a town of Austria; 8 miles N.E. of Listerdorf.

RABENSTEIN, a town of Austria, on the river Bielach; 8 miles S. of St. Polten.

RABENSTEIN, a town of Bohemia, in the circle of Leitmeritz; 40 miles E. of Prague. N. lat. 50° . E. long. $13^{\circ} 26'$.—Also, a town of the duchy of Stiria; 11 miles N.N.W. of Gratz.—Also, a town of Bavaria, in the bishopric of Bamberg; 2 miles S. of Weischenfeld.

RABIA PRIOR, in *Chronology*, is the name of the third month of the Arabic year, consisting of thirty days; and *Rabia posterior* is the name of the fourth month, consisting of twenty-nine days.

RABICH, a name given by Leo Africanus to a tree or shrub growing very plentifully in many parts of Africa, the fruit of which is much esteemed by the natives. He says that the tree rabich is prickly, and that the fruit is round, and like a cherry, but smaller, and of the taste of the jujube.

RABIEL, a name given by some authors to dragon's blood.

RABIES, in *Medicine*, that peculiar state of the nervous system, which is produced by the bite of a rabid animal, and which is commonly, but improperly, called *madness*. As the dog is the principal source of this disease, the word rabies is commonly united with the epithet *canina*. See HYDROPHOBIA.

RABINAL, in *Geography*, a town of Mexico, in the province of Vera Paz; 40 miles S.S.W. of Vera Paz.

RABINET, a name formerly given to a small piece of ordnance, between a falconet and a base. Its dimensions, &c. see under CANNON.

RABIRA, a word used by some of the chemical writers to express tin.

RABISHI, in *Geography*, a river of the island of St. Vincent, forming a bay on the eastern coast, near the southern extremity, where it runs into the sea. N. lat. $13^{\circ} 5'$. W. long. $61^{\circ} 11'$.

RABLAY, a town of France, in the department of the Mayne and Loire; 9 miles N. of Villiers.

RABLES, *Isles aux*, a cluster of small islands at the entrance of lake Superior, in Upper Canada, and at the east end of it, east of White Fish island, and pretty close to the main land.

RABNABAD, a town of Hindoostan, in Bengal, at the mouth of the Ganges; 90 miles S.S.E. of Mahmud-pour.—Also, a small island on the coast of Bengal, at the mouth of the Ganges. N. lat. 22° . E. long. $90^{\circ} 30'$.—Also, one of the mouths of the Ganges, which opens into the bay of Bengal. N. lat. 22° . E. long. $90^{\circ} 26'$.

RABNITZ, a river of Hungary, which runs into the Danube, a little below Raab.

RABOGH, a town of Arabia, in the province of Yemen, near the coast of the Red sea, where the Arabs live in huts; 105 miles S.W. of Medina.

RABOLANE, in *Ornithology*, a name given by many to the lagopus, a bird found on the snowy mountains, and called by some the white partridge.

RABRI, a name given by some authors to bole armenic.

RABUEL, CLAUDE, in *Biography*, a French Jesuit and able mathematician, was born at Pont-de-Vele, in the county of Bresse, in the year 1668. About the age of 18 he was entered into the society of Jesus, and principally distinguished himself by his proficiency in mathematical learning, of which he became the professor in Trinity college at Lyons, performing its duties with great reputation and success. He died in 1728, in the 60th year of his age. His chief work was "A Commentary on the Geometry of Descartes," which was published after his death in 1730, under the care of father l'Esplanne. This was the first illustration of the whole of that work, which had been given to the public. The labours of Fermat, De Witt, and others, extended only to particular parts of it. Rabuel left behind him other works on algebra, the conic sections, and the geometrical loci of the differential calculus, and of the integral calculus; and he was one of the few instances of persons who, with a passion for the mathematics, had a fine taste for polite literature.

RABUTAH, in *Geography*, a town of Africa, in the kingdom of Sennaar; 35 miles S.S.W. of Sennaar.

RABUTIN, FRANCIS DE, in *Biography*, who flourished in the sixteenth century, was of an ancient and noble family in Burgundy, and served in the army with the duke de Nevers, under Henry II. and Charles IX., with a high reputation for valour and fidelity. He was living in 1581, but nothing is known of him beyond that period. He was author of "Commentaires de dernières Guerres du Roi Henri II. et de l'Empereur Charles Quint," first printed in 1555; a continuation was printed afterwards, in 1558; and the whole work together in 11 books, in 1574. It contains a history of the wars in the Low Countries, from 1550 to 1558, and is said to be written in a simple style, with a great appearance of vivacity.

RABUTIN, ROGER DE, count of Bussi, a very distinguished character in the reign of Lewis XIV., was born at Epiry, in the Nivernois, in 1618. He entered very young into the army, in his father's (Leonor Baron of Bussi) regiment, of which he became colonel. After serving in a number of battles and sieges, he rose to the rank of mestre-de-camp of the light horse, and lieutenant-general of the Nivernois. He looked for still higher honours, and being disappointed, engaged in lampoons upon persons about the court, which drew upon him the king's displeasure; and in 1665, in which year he was admitted a member of the French academy, a manuscript history of the amours of two court ladies, of which he was the writer, being handed about, under the title of "Histoire Amoureuse des Gaules," a complaint was laid before his majesty, in consequence of which he was sent to the Bastille. Imprisonment had nearly proved fatal to him, and he was liberated, but was obliged to resign the office which he held under government. After this he was exiled to his country-seat, where he remained 17 years, during which he did not cease to importune the king to be allowed to return, by letters conceived in terms of abject humility and base adulation. In 1682 he was allowed to return to court, but finding himself generally neglected, he retired of his own accord to his estates. He died at Autun in 1693, at the age of 75. He was author of several works, among which were "Discours a ses Enfants, sur le bon Usage des Adversités;" "Memoires," published first at Paris in two, and afterwards at Amsterdam in three volumes, 4to.; "Lettres," 7 vols. 12mo.; and "Histoire Abregee de Louis le Grand." His son the abbé de Bussi became bishop of Luçon in 1723, and was a learned and ingenious member of the French academy.

The sister of the bishop, a nun, published an abridgment of the life of Madame de Chantal, and of the life of St. Francis de Sales.

RABY, in *Geography*, a small township of America, in New Hampshire, in Hillsborough county; about 65 miles W. by S. of Portsmouth; incorporated in 1790. Its name has been since changed.—Also, a town of Bohemia, in the circle of Prachatitz, containing a citadel, at the siege of which, Zisca, general of the Hussites, lost his only remaining eye; 4 miles S. of Horazdiowitz.—Also, a town of Sweden, in Sudermanland; 7 miles N. of Nykoping.

RACA, or RACHA, a Syriac term, found in the Gospel of St. Matthew, chap. v. 22. and preserved in most translations.

Father Simon observes, that the Greek translator of St. Matthew's Gospel retained the Syriac raca, which he found in the original, because it was very common among the Jews. And St. Jerom, Luther, the English translators, those of Geneva, Louvain, Port royal, &c. still preserve it in their respective languages.

F. Bonhours chooses rather to express the sense of it in a sort of paraphrase, thus: he that says to his brother, *homme de peu de sens, man of little understanding*, shall deserve to be condemned by the tribunal of the council, &c.

Most translators, except the English, and F. Simon, for raca write racha; but the former orthography seems the best founded; all the Latin copies having raca, and all the Greek ones *para*, or, with Hesychius, *parra*, which is the same; all, we mean, but St. Irenæus, and Beza's copy, now at Cambridge, which have *para*. In effect, the origin of the word shews it should be raca; as coming from the Syriac *רָקָא*, raca, of the Hebrew *רק*, *rek*, empty, *shal-lu*.

RACAISSONE, in *Geography*, a town of Hindoostan, in Aurungabad; 30 miles S. of Aurungabad.

RACAM, a town of New Mexico, in the province of Hiaqui; 60 miles S.W. of Riochico.

RACAN, HONORAT DE BUEIL, Marquis of, in *Biography*, a French poet, was born in 1589, of a noble family, in Touraine. When very young, he had a place in the king's bed-chamber, under the duke of Bellegarde. From Malherbe, who was at that time domesticated with the duke, he acquired a fondness for poetry, and obtained instructions in the art of versifying. He at first bore arms, as a profession; but after a time he devoted himself to a life of leisure. He was one of the earliest members of the French academy, and though almost wholly without the advantages of education, he obtained reputation as a writer. His most popular work was entitled "Bergeries." He composed in various styles, and wrote translations of Psalms, and many sacred odes taken from the Psalms, and other scriptural poems. In prose he published "The Life of Malherbe;" "A Discourse pronounced before the Academy;" and some "Letters." He died in 1670, at the age of 81. Of his works a new edition was given at Paris, in 1724, in 2 vols. 12mo.

RACCA, RACAN, Rika, or Racka-Rica, in *Geography*, a town of the Persian empire, in the province of Diarbekir, and pashalic of Orfu, the capital of the district named Diar Modzar. It is situated on the eastern bank of the river Euphrates, at the mouth of a small river named Beles, (the ancient Bilicha,) and was founded, according to Pliny, by Alexander the Great. It was first called Nicephorium, and afterwards Callinicum and Leontopolis, from Seleucus Callinicus and the Greek emperor Leo. It was the favourite residence of Haroun al Rasehid, the ruins

ruins of whose palace, it is said, are still visible. The position of Racca, in the parallel of 36° N., was ascertained by the celebrated oriental astronomer Mahomed Ben Jaber, furnished Al Batani, who passed many years of his life at this place. The town and adjoining country are inhabited by different tribes of wandering Arabs. N. lat. $36^{\circ} 1'$. E. long. $38^{\circ} 50'$.

RACCAN, a river on the north coast of Sumatra, which runs into the sea, N. lat. $2^{\circ} 30'$. E. long. $100^{\circ} 15'$.

RACCANATTO, a river of Naples, which runs into the gulf of Tarento, N. lat. $39^{\circ} 47'$. E. long. $16^{\circ} 42'$.

RACCOON, in *Zoology*. See RACKOON.

Raccoon, in *Geography*, an island in the Atlantic, near the coast of South Carolina, nine miles long and one wide. N. lat. $33^{\circ} 3'$. W. long. $79^{\circ} 22'$.

Raccoon Creek, a river of Pennsylvania, which runs into the Ohio, N. lat. $40^{\circ} 38'$. W. long. $80^{\circ} 25'$.

Raccoon Island, a small island in Ossabaw sound, belonging to the state of Georgia. N. lat. $31^{\circ} 47'$. W. long. $81^{\circ} 12'$.

Raccoon Key, a small island or rock in the gulf of Mexico, near the south coast of West Florida. N. lat. $29^{\circ} 46'$. W. long. $89^{\circ} 21'$.

Raccoon Keys, a cluster of small islands near the coast of South Carolina. N. lat. $24^{\circ} 8'$. W. long. $79^{\circ} 15'$.

RACOURCY, in *Heraldry*, signifies the same as *coupé*, that is, *cut off*, or *shortened*; and denotes a cross, or other ordinary, when it does not extend to the edges of the escutcheon, as they always do when absolutely named, without such distinction.

RACE, in general, signifies running with others, in order to obtain a prize, either on foot, or by riding on horseback, in chariots, &c.

Racing was one of the exercises among the ancient Grecian games, which was performed in a course, containing one hundred and twenty-five paces; and those who contended in these foot-races were frequently clothed in armour. For a particular account of these races, see STADIUM.

There were properly but two kinds of horse-races at Olympia, namely, the *chariot-race*, introduced into those games in the 25th olympiad (for an account of which see CHARIOT), and the race of riding-horses, which was not admitted till the 33d. Although chariots were in use before riding-horses, as we may conclude from the testimony of Homer, among all whose heroes, Greek and Trojan, no one makes his appearance on horseback, except Diomedes and Ulysses mounted upon the horses of Rhesus (Il. x.), it is nevertheless plain, from this instance, that neither the heroes nor the horses were utter strangers to the art of riding; and it is also evident, from another passage in the 15th Iliad, that horsemanship was carried even to some degree of perfection, at least in the time of that poet, who lived but in the next generation after the siege of Troy, according to sir Isaac Newton. This passage, extracted from Pope's Homer (Il. xv. v. 822.) is as follows:

“ So when a horseman from the wat'ry mead
(Skill'd in the manage of the bounding steed)
Drives four fair couriers, practis'd to obey,
To some great city, thro' the public way:
Safe in his art, as side by side they run,
He shifts his seat, and vaults from one to one:
And now to this, and now to that he flies:
Admiring numbers follow with their eyes.”

Some authors (see Rollin's Anc. Hist. tom. v. p. 72. ed. Amst.) have introduced an exercise like this into the

Olympic games, though Mr. West professes himself dissatisfied with the authority upon which they depend: and says that in the books which he has consulted, he can find no mention of any other race of riding-horses, besides those of the *Celes* and the *Calpé*. As to that particular branch of horsemanship, above described, Eustathius, in his comment upon Homer, tells us, that in the old scholia it is written, that Demetrius says he had seen a man, vaulting in the manner described by the poet, from the back of one horse to another, holding the bridles at the same time, and keeping the horses to their speed, without any interruption or incumbrance. This assertion implies that such a fight was very uncommon, and consequently that no such exercise could ever have been admitted into any of the games of Greece. The word *Κελήσις*, used by the poet in the beginning of this simile, says Mr. West, may possibly have induced some people to imagine, that the riders of the horses called *Κελήσις*, *celetes*, were accustomed to leap from one horse to another, as if that word was a term of the manege, of which the verses that follow were merely an explanation. It is certain, however, from a passage in the *Odyssæy* (E. v. 371.) that by *ἵππος Κέλης*, Homer meant to signify no more than a riding-horse, and consequently that by the word *Κελήσις*, which is derived from *Κέλης*, no more is to be understood in this place than simply to ride. This interpretation of *Κέλης*, *celes*; may be farther confirmed by the authorities of Pindar and Pausanias, and particularly by a story related by the last mentioned author (lib. vi. c. 13.) of a mare, named Aura, belonging to one Phidolas, a Corinthian. This mare, says the historian, having accidentally thrown her rider soon after she had started from the barrier, continued the race of her own accord, and turned round the pillar as if the rider had been still upon her back; upon hearing the trumpet, she mended her pace, till coming in before her antagonists, she stopped short over-against the judges of the games, as conscious of having gained the victory. The victory was accordingly adjudged to her master Phidolas, who, by erecting in return a statue to her honour, intimated to whom the merit of that victory was due. In this story, there is no mention of any other horse or mare, that shared the victory with Aura, and consequently that, in the race called *Celes*, each competitor made use of but one single horse. Moreover, the victorious Aura was of the feminine gender, and hence we may infer, that in all the races, as well of riding horses as of chariots, mares or horses were indifferently used; excepting in the race named *Calpé*, in which mares only were employed. And further it appears, that though the rider was thrown off in the very beginning of the race, yet the crown was awarded to Phidolas, the master of Aura; to whom certainly no less was due, than if his mare had conquered under the conduct and discretion of her rider. It appears also, by the circumstance of Aura's mending her pace upon hearing the trumpet, that the trumpet either did not sound during the whole race, but at the last round only, or that it sounded differently in different periods of the course. There was, however, a meaning in the sound of the trumpet, which Aura, probably an old stager, understood.

The race of full-aged riding-horses was instituted in the 33d olympiad, and that of the *Πωλός*, *Κελήσις*, or under-aged riding-horses, in the 131st. It is a well-known fact that chariots were used in war above 1000 years before cavalry was introduced among the ancients. They seem to have had a terrible notion of being mounted upon the back of a horse, and have accordingly made monsters of those whom they first beheld in that attitude, to which they were not very speedily reconciled. Their amazement gradually diminished: and their intercourse with other nations not only

rendered riding-horses familiar to them, but convinced them likewise of the advantages accruing from the use of cavalry. Hence it came to pass, that an order of equites, or horse-men, was instituted in most of their commonwealths; to whom, as in Athens, was allotted the second rank in the state. Upon the same principle, perhaps, the ἵππος κελύς, or riding-horse, was admitted into the Olympic hippodrome, and held in such estimation, that although the race of riding-horses was neither so magnificent nor so expensive, and consequently not so royal, as the chariot-race, yet we find, among the competitors in this exercise, the names of Philip, king of Macedon, and Hiero, king of Syracuse. To the latter is inscribed the first Olympic ode of Pindar, in which honourable mention is made of the horse Phœnicus, whose fleetness gained for his master the Olympic crown. The race of the Calpé was performed by mares. (See CALPÉ.) The length of this race, and also that of the Celes, are not ascertained; but it is reasonable to suppose, that the latter, distinguished, as we have already observed, into two classes, one of full-aged, and the other of under-aged horses, consisted of the same number of rounds as those of the chariots, distinguished in like manner into two classes. Mr. Weft has not been able to determine the different ages that ranked the horses in one or the other class; nor whether the weight of the riders, or the sizes of the horses, were taken into consideration. These points seem to have been left to the discretion of the Hellanodicks, who were appointed to examine the young horses that were entered to run for any of the equestrian crowns (Paus. l. iv. c. 24.), and who were sworn before the statue of Jupiter Horcius, to give a true and impartial judgment upon the matters left to their examination, without taking any reward; and not to discover the reasons which disposed them to reject some, and admit others. Weft's Dissertation on the Olympic Games. Sect. 14. See HIPPODROME.

RACE, in *Genealogy*, a lineage, or extraction, continued from father to son.

The word is French, formed from the Latin *radix*, root; as intimating the root of the genealogical tree.

In several orders of knighthood, as in that of Malta, &c. the candidates must prove a nobility of four races or descents.

In some republics the magistrates are to prove themselves of plebeian race, to be qualified.

The French reckon their kings by races; as, the first race, the second race, the third race. We also say the race of the Ottomans, the Arsacidæ, the Ptolemies, &c.

RACE, in *Natural History*. See CIBDELOPLACIA.

RACE, the mark made on timber, &c. by a tool called a racing-knife.

RACE, *Cape*, in *Geography*, a cape on the S.E. coast of Newfoundland. N. lat. 46° 40'. W. long. 53° 3' 30".

RACE Point, a cape on the coast of America, W. of Cape Cod. N. lat. 42° 4'. W. long. 78° 12'.

RACEME, in *Gardening*, the long mode of cluster-flowering and fruiting which takes place in some sorts of plants and fruit-trees, as in the grape vine, and the different kinds of currants. See RACEMUS.

RACEMIFEROUS, in *Botany*, denotes bearing in clusters.

RACEMUS, in *Botany* and *Vegetable Physiology*, a cluster, is a mode of inflorescence, in which several flowers, each supported on its own proper stalk, are connected by one common stalk, either simple or compound. A bunch of Currants is a simple *racemus*; the inflorescence of the Woody Nightshade, *Solanum Dulcamara*, is a compound one. In the American plant called *Ælea racemosa*, the clusters are

simple, but aggregate. A *racemus* differs from a *spica*, or spike, in having a partial stalk, as above described, to each flower; it is moreover generally understood to be drooping or pendulous, and to have the flowers expand all nearly at one time. On the contrary, a spike is most frequently erect; the flowers open in very gradual succession, inasmuch that the lowermost may have partly perfected their seeds, before the uppermost expand; and especially, they are individually sessile, at least at the time of their expansion. To these characters may be added, that a spike is crowded or dense; a cluster lax or scattered. It must be allowed that botanists, even of the first rank, are incorrect in the application of these terms. The male inflorescence of *Quercus*, the Oak genus, because drooping and loosely disposed, with all the flowers in perfection nearly at the same time, is termed a *racemus*; though it possesses the most essential character of a *spica*, sessile flowers. On the other hand, *Veronica spicata*, having a dense upright series of flowers, expanding gradually, is said to be spiked, though each separate flower has a partial stalk. A little latitude must necessarily be allowed, though it is very desirable that botanists should be more exact in the use of these and other terms, than they sometimes are. See SPICA and INFLORESCENCE.

RACER, in *Gardening*, a name applied to a sort of sward-cutter, or cutting implement, used in racing out or cutting through the surface of grass sward, and dividing it into proper widths, lengths, and thickness, for turf intended to be cut up for laying in pleasure-grounds, or other places, and always necessary preparatory to the work of flaying or cutting up the turf with the turving-iron. It is also useful for cutting and straightening the edges of grass verges in such grounds, as well as for many other purposes.

It is a tool which is very simple in its construction, merely consisting of a strong wooden handle, about four feet long, having the cutter fixed at the lower end, in the form of a half moon, with the edge downward, to cut into the sward; the handle should be about an inch and a half thick, growing gradually thicker towards the lower end.

In using the tool, it is pushed forward so as to cut or race out the sward in an expeditious manner. And in cutting turfs with it, it is necessary first to mark out on the sward the width of the turf intended, which should generally be a foot wide, and a yard long, and about an inch or inch and a half deep; then strain a line tight, first lengthways, striking the racer into the sward close to the line, running it along expeditiously, so as to cut its way, and divide the sward to a proper depth, afterwards placing a line a foot farther, and racing it out as before, and so on, to as many widths as may be wanted; and then, with the line placed cross-ways, to race out the sward accordingly in yard lengths. The sward being thus raced out, the turf-cutter with the turving-iron should proceed to cut them up and flay them off from the ground. This small implement is likewise very convenient for many other little purposes about pleasure grounds and gardens, as those of cutting the edges of the verges which are laid with turf, and straightening the edges of the borders in different parts. See TURF.

RACHA. See RACA.

RACHA, in *Geography*, a town of Bohemia, in the circle of Leitmeritz; 8 miles E. of Leitmeritz.

RACHELSDORF, a town of Bavaria, in the bishopric of Bamberg; 15 miles N. of Bamberg.

RACHETUM, from the Fr. *racheter*, *redimere*, the compensation or redemption of a thief.

RACHIA,

RACHIA, in *Geography*, a town of Istria; 7 miles N.E. of Pedena.

RACHIALGIA, in *Medicine*, a term given by Astruc, and adopted by the nosologists, to denote certain colicky pains in the bowels, which were supposed to originate from the nerves of the spine, and especially the colic from the poison of lead, or *COLICA Pidonum*; which see. The word is from *ραχις*, the spine, and *αλγν*, pain. See Sauvages Nosol. Meth. class vii. gen. 29.

RACHIS, or rather *Rhachis*, in *Botany*, from *ραχις*, the back-bone, is the common stalk, or receptacle, of the florets, in the spikelets of grasses; or of the spikelets themselves in *Lolium*, *Triticum*, *Secale*, *Hordeum*, *Rottböllia*, &c. The same term is applied to the rib, or leaf-stalk, of ferns, which is often winged or bordered. The *Rachis* in both these instances is frequently jointed; by which in the former, the ripe seeds of such grasses, wrapped up in their husks, are the more readily dispersed. The part in question being in some cases smooth, in others variously hairy or bearded, affords excellent specific distinctions; witness the genus *Avena*.

RACHISAGRA, a term used by some physicians for the gout in the spine of the back.

RACHITIS, in *Medicine*, from *ραχις*, the spine, (because the spinal marrow was supposed to be the seat of the disease), a malady corruptly termed in English the *Rickets*: which see.

RACH-KOKE, in *Geography*, one of the Kurilskoi or Kuril islands in the Eastern or Pacific ocean: distant from Muf-fyr, another of the said islands, about 120 versts. Its length is about 20 versts, and its breadth the same, and it presents the appearance of a solitary mountain rising upwards from the sea. It was formerly covered with verdure, with shelves of rocks, where sea-fowl in great number made their nests: but these rocky shelves have been demolished by the eruption of subterraneous fires, which split the summit of the mountain, throwing up vast quantities of stones and ashes; and since that time, the island has always continued burning. At this eruption those places on the shore where formerly they had thirteen fathom water, were filled up with rubbish and ashes into shoals and banks.

RACHLIN, in *Ancient Geography*, the *Ricina* of Ptolemy, near the N.E. coast of Ireland, memorable as the retreat of Robert I. of Scotland.

RACHOL, in *Geography*, a town of Hindoostan, in Soonda; 16 miles S.S.E. of Goa.

RACHORE, a district or province of Hindoostan, in Golconda, bounded on the N. by the Kistnah, on the E. by Canoul, on the S. by Adoni, and on the W. by Sanore.—Also, a town of Hindoostan, and capital of the above-mentioned province, on the S. side of the Kistnah, and not far above the conflux of the Toombudda with it, and below that of the Beemah; belonging to the Nizam. It is four days' journey from Adoni, reckoning a day's journey at 22 British miles in road distance, and 17 or 18 geographical miles; 91 miles S.W. of Hydrabad. N. lat. 16° 24'. E. long. 78° 2'.

RACHOSIS, from *ραχος*, *lacero*, a disease, in which the scrotum is relaxed and excoriated.

RACHOUR, in *Geography*, a town of Hindoostan, in the circar of Gurry Mundella; 20 miles S.S.W. of Gurrach.

RACHOURE, a town of Hindoostan, in Mysore; 20 miles S. of Gurraneconda.

RACHOW, a town of Poland; 36 miles S.S.W. of Lublin.

RACINE, JOHN, in *Biography*, an eminent French poet,

was born in 1639. He was educated at the convent of Port-Royal, near Paris; after this he went through a course of philosophy at the college of Harcourt, and then made his appearance before the public in an ode on the king's marriage. This effort was, through the interest of Colbert, rewarded with a present and a small pension. Elated with the success that crowned his first effort, he determined to follow poetry as a profession; and, rejecting the offer of an uncle, a prior, who offered to resign his benefice to him, provided he would enter into holy orders, he fixed his residence at Paris. In 1664 he brought upon the stage his first tragedy, entitled "*La Thebaïde ou les Frères ennemis*." It was written in the manner of Corneille, which he soon after quitted for one of his own; a judicious change, says a critic, since the characteristics of these two masters of the French drama were extremely different. He next published his "*Alexandre*," which was followed by his "*Andromaque*." About this time he was presented to the priory of Epinay, but not being in orders, he was, after a law-suit, obliged to quit. His "*Andromaque*," which established his character as a tragedian, was soon followed by the comedy "*Les Plaideurs*," which, though it obtained for him the praise of Moliere, and was well received at court, was his only attempt in that walk. Between the years 1670 and 1678, he published his "*Britannicus*," "*Berenice*," "*Bajazet*," "*Mithridate*," "*Ephigene*," and "*Phædre*." His popularity and well-earned reputation excited a strong party against him: the chagrin which he underwent from the artifices of his enemies, and the over-sensibility to criticism, which led him to confess, in the confidence of friendship, that the worst critique made upon his works caused him more uneasiness than the greatest plaudits had given him pleasure, inspired him with the resolution of renouncing poetry and turning Carthusian. He was, however, persuaded to change his plan, and to marry: he accordingly formed an alliance with the daughter of a gentleman in the treasury of Amiens, by whom he had several children. At the same time he ceased to write for the stage, and thereby reconciled himself with his old friends of the Port-Royal. Racine now became a courtier, and obtained the situation of gentleman in ordinary to the king, to whom he made himself very useful. He was also appointed to the office of historiographer-royal, in conjunction with his friend Boileau, which they made a complete sinecure. He was prevailed upon by madame Maintenon to write a dramatic piece on a scriptural subject, for the ladies of her foundation of St. Cyr, and his "*Esther*" was performed by them in 1689, with great applause, in the presence of the whole court. He followed it with "*Athalie*," acted by the same ladies in 1691. Madame Maintenon, deeply affected with the miseries of the people in the latter years of Lewis's reign, engaged Racine to draw up a memoir on the subject. This he did in so free a manner, as to give great offence to the king, who happened to obtain a sight of it from a lady to whom it had been lent. Racine was excluded from the court, a circumstance that so preyed upon his mind, that he fell into a state of melancholy, of which he died in 1699, at the age of 60. For a character of this writer we shall be indebted chiefly to the General Biography. He was polite in his manners, with the affected softness of a courtier, which was, however, a mask to his actual disposition, for, in reality, he had much gall and spleen in his character. Religion, however, corrected, in a good measure, these defects, and in all the relations of domestic life he was exemplary. As a dramatic writer he is supposed to have ranked with Corneille, though in many points he even surpassed him. His characteristics are tenderness,

ness, elegance, correctness, good taste, refined sentiments, and the art of versifying in a supreme degree, so that his countrymen find a charm in his lines, which distinguishes them from other French poetry. The criticisms of Boileau contributed much to his excellence in this particular, and he is said to have taught him, as a great secret, to write the second line of a couplet first. With respect to the proper dramatic merit, Racine must be judged by those who are formed to the French school, and are not readily wearied with long speeches, rather descriptive of feeling than expressing it, and all refinements of the tender passion, often applied to characters, to which it is historically unfuitable. Many parts of his best pieces, however, prove that his mind was well furnished with elevated and dignified sentiments, which he probably derived from an assiduous study of the ancients. Besides his dramatic works, Racine was author of "Cantiques," replete with the unctious of tender devotion; "L'Histoire de Port-Royal;" "Idylle sur la Paix;" "Epigrams;" Letters;" and some "Opuscules." He was member of the French academy from 1673, and as director of that institution he pronounced the eulogy of Corneille. The best edition of his works is in seven vols. 8vo. 1768.

RACINE, LOUIS, son of the preceding, also a distinguished poet, was born at Paris in 1692. He was, however, not more distinguished for his poetry than for his piety, and adopted the ecclesiastical habit. In a state of retirement, in 1720, he published his poem "On Grace." The chancellor d'Aiguillon, during his own exile at Fresnes, brought Racine again into the world, and cardinal Fleury afterwards gave him a place in the finances. He married, and lived very happily in his family, till the loss of an only son threw him into a deep melancholy. His religious sentiments took full possession of his soul, the fervour of which may be estimated by the line from Tibullus which he inscribed on the crucifix which ever accompanied him:

"Te spectem suprema mihi cum venerit hora,
Te teneam moriens deficiente manu."

He died in 1763, at the age of 71. His poetical writings are "Poems on Religion and Grace;" "Odes," of which the diction is splendid, and the sentiments elevated; "Epistles," and a "Translation of Milton's Paradise Lost." In prose he wrote "Reflexions sur la Poésie;" "Memoires sur la Vie de Jean Racine;" "Remarques sur les Tragedies de J. Racine;" besides these he contributed several dissertations to the Memoires of the Academy of Inscriptions, of which he was a member. His works were collected and published in 6 vols. 12mo.

RACINE, BONAVENTURE, a learned French priest and ecclesiastical historian, was born at Chauny, in the diocese of Noyon, in the year 1708. He received an excellent education at the Mazarin college at Paris, where he not only studied the ancient languages, but entered pretty fully into the different branches of philosophy, divinity, and the studies connected with ecclesiastical history. At the age of twenty-one he was entrusted by the archbishop of Alby, as a fit person, to re-establish the college of Rabastens, a town in his diocese. To this design he devoted his talents with unwearied zeal and assiduity, and was abundantly compensated by the success which attended his labours. The institution was, in a short time, crowded with students, who imbibed from his lectures a taste for science and literature. Thus usefully engaged, he became an object of the jealousy of the witty Jesuits, who caused him to be banished from Rabastens. He retired to Montpellier, where M. Colbert engaged him to undertake the direction of the college of Lunel: from this place he was also driven by the same per-

secutors, and he found it necessary to withdraw secretly to Paris, where he was invited to undertake the education of certain young persons at the college of Harcourt, in connection with some other ecclesiastics. Here his old enemies the Jesuits pursued him, and an order was obtained from cardinal Fleury, in 1734, to deprive him of his office of tutor. In the following year M. de Caylus, bishop of Auxerre, nominated him to a canonry in his cathedral, and ordered him priest; but his new dignity produced no alteration in his manner of living, nor in the distribution of his time, which was almost wholly spent in devotion and study. From this time he set about preparing to publish the collections that he had made in ecclesiastical history, and in 1748 he sent into the world the first volumes of an "Abridgment of Universal History, containing the principal Events in every Century, with Reflections," in 12mo. These were followed by others, to the number of thirteen, the last making its appearance in the year 1754. This work, written in a neat, perspicuous, and simple style, was well received, and became extremely popular. The labour which it cost him his weak constitution was unable to sustain; he sunk under his exertions in the 47th year of his age. He was characterized by the excellence of his manners and the amiableness of his temper, and he had an ardent zeal for what he regarded as truth, which approached to enthusiasm. Two other volumes have been added since his death to the History, but they are the work of an inferior hand, and unworthy of being placed in conjunction with those of Racine. Moreri.

RACING, the riding of heats for a plate or other premium. Horses for this use should be as light as possible, large, long, and well-shaped, nervous, of great mettle, and good wind, with small legs, and neat small-shaped feet.

The first thing to be considered in this sort of gaming is the choice of a rider; for it is not only necessary that he should be very expert and able, but he must also be very honest.

He must have a very close seat, his knees being turned close to the saddle skirts, and held firmly there, and the toes turned inwards, so that the spurs may be turned outward to the horse's belly; his left hand governing the horse's mouth, and his right the whip. During the whole time of the race, he must take care to sit firm in the saddle, without waving or standing up in the stirrups. Some jockies fancy this is a becoming seat, but it is certain, that all motions of this kind do really incommode the horse. In spurring the horse, it is not to be done by sticking the calves of the legs close to the horse's sides, as if it were intended to press the wind out of his body; but, on the contrary, the toes are to be turned a little outwards, that the heels being brought in, the spurs may just be brought to touch the sides. A sharp touch of this kind will be of more service toward the quickening of a horse's pace, and will sooner draw blood than one of the common coarse kicks. The expert jockey will never spur his horse until there is great occasion, and then he will avoid striking him under the fore-bowels between the shoulders and the girth; this is the tenderest part of a horse, and a touch there is to be reserved for the greatest extremity.

As to whipping the horse, it ought always to be done over the shoulder, on the near side, except in very hard running, and on the point of victory; then the horse is to be struck on the flank with a strong jerk; for the skin is the most tender of all there, and most sensible of the lash.

When a horse is whipped and spurred, and is at the top of his speed; if he claps his ears in his pole, or whisks his tail, it is a proof that the jockey heats him hard, and then he ought to give him as much comfort as he can, by sawing

RACING.

ing the snaffle backwards and forwards in his mouth, and by that means forcing him to open his mouth, which will give him wind, and be of great service. If there be any high wind stirring in the time of riding, the artful jockey will let his adversary lead, holding hard behind him, till he sees an opportunity of giving a loose; yet in this case, he must keep so close behind, that the other horse may keep the wind from him; and that he, sitting low, may at once shelter himself under him, and assist the strength of the horse. If the wind happen to be in their back, a just contrary method is to be taken with it; the expert jockey is to keep directly behind the adversary that he may have all the advantage of the wind to blow his horse along, as it were, and at the same time intercept it in regard to his adversary.

When running on level carpet-ground, the jockey is to bear his horse as much as the adversary will give him leave, because the horse is naturally more inclined to spend himself on this ground: on the contrary, on deep earths he may have more liberty, as he will there spare himself.

In riding up hill the horse is always to be favoured, by bearing him hard, for fear of running him out of wind; but in running down hill, if the horse's feet and shoulders will bear it, and the rider dares venture his neck, he may have a full loose. If the horse have the heels of the rest, the jockey must always spare him a little, that he may have a reserve of strength, to make a push at the last post.

A great deal depends on the jockey's knowing the nature of the horse that is to run against him; for by managing accordingly, great advantages are to be obtained: thus, if the opposite horse is of a hot and fiery disposition, the jockey is either to run just behind him, or cheek by jowl with him, making a noise with the whip, and by that means forcing him on faster than his rider would have him, and consequently spending him so much the sooner; or else keep just before him, in such a slow gallop, that he may either over-reach, or by treading on the heels of the fore horse, endanger tumbling over.

Whatever be the ground that the adversary's horse runs worst on, the cunning jockey is to ride the most violently over; that by this means it will often happen, that in following he either stumbles or claps on the back sinews. The several corrections of the hand, the whip, and the spur, are also to be observed in the adversary, and in what manner he makes use of them: and when it is perceived, by any of the symptoms, of holding down the ears, or whisking the tail, or stretching out the nose like a pig, that the horse is almost blown, the business is to keep him on to this speed, and he will be soon thrown out, or distanced. If the horse of the opponent looks dull, it is a sign his strength fails him; and if his flanks beat much, it is a sign that his wind begins to fail him, and his strength will soon do so too.

After every heat for a plate, there must be dry straw, and dry cloths, both linen and woollen, ready to rub him down all over, after taking off the sweat with what is called a sweat-knife; that is, a piece of an old sword-blade, or some such thing. Some advise the steeping of the cloths in urine and saltpetre the day before, and letting them be dried in the sun for this occasion. After the horse has been well rubbed with these, he should be chafed all over, with cloths wetted in common water, till the time of starting again. When it is certainly known that the horse is good at the bottom, and will stick at the mark, he should be rid every heat to the best of his performance; and the jockey is, as much as possible, to avoid riding at any particular horse, or staying for any, but to ride out the whole heat with the

best speed he can. If, on the contrary, he has a fiery horse to ride, and one that is hard to manage, hard-mouthed, and difficult to be held, he is to be started behind the rest of the horses with all imaginable coolness and gentleness; and when he begins to ride at some command, then the jockey is to put up to the other horses; and if they ride at their ease, and are hard held, they are to be drawn on faster; and if it be perceived that their wind begins to rake hot, and they want a sob, the business is to keep them up to that speed; and when they are all come within three quarters of a mile of the post, then is the time to push for it, and use the utmost speed in the creature's power.

When the race is over, the horse is immediately to be clothed up, and rode home; and immediately on his coming into the stable, the following drink is to be given him. Beat up the yolks of three eggs, and put them into a pint and a half of new milk made warm; let there be added to this three pennyworth of saffron, and three spoonfuls of fallad-oil, and let the whole be given with a horn. After this he is to be rubbed well down, and the saddle-place rubbed over with warm sack, and the places where the spurs have touched, with a mixture of urine and salt, and afterwards with a mixture of powder of jet and Venice turpentine; after this he should have a feed of rye-bread, then a good mash, and at some time after these as much hay and oats as he will eat. His legs, after this, should be bathed some time with a mixture of urine and saltpetre.

For the preparation of the horse before running, &c. see **PLATE**.

We shall here observe, that horse-races were a species of amusement known in England in very early times. Fitz-Stephen, who wrote in the days of Henry II. records the great delight which the citizens of London took in the diversion. Races appear likewise to have been in vogue in the reign of queen Elizabeth, and to have been carried to such excess as to have injured the fortunes of the nobility. Lord Herbert of Chesham (see his *Life* by Mr. Walpole, p. 51.) enumerates these among the sports which he thought unworthy of a man of honour. "The exercise," says he, "I do not approve of in running of horses, there being much cheating in that kind; neither do I see why a brave man should delight in a creature whose chief use is to help him to run away." Jarvis Markham, who wrote on the management of horses in 1599, mentions running horses; but at this time there were only private matches made between gentlemen, who were their own jockies, and rode their own horses. However, in the following reign of James I., public races were established; and Garterly, in Yorkshire, Croydon, near London, and sometimes Theobald's, near Enfield-chace, where the king resided, were the courses in which they were performed. The horses at this time were prepared for running by the discipline of food, physic, airing, and sweats and clothing, which compose the present system. The weight also which each horse was to carry was rigidly adjusted: the usual weight of the riders being stated at ten stones, who were put into scales, and weighed before they started. Most of the celebrated races in the kingdom were called bell-courses, the prize and reward of the conquering horses being a bell. To this purpose, Camden says, that in 1607 there were races near York, and the prize was a little golden bell. Upon this Berenger offers a conjecture, whether the phrase of *bearing the bell*, which implies being comparatively the best or most excellent, and corresponds with the expression of bearing the palm among the ancients, as a reward decreed to the swiftest horse in a race, is not more aptly deduced from this custom,

custom, than from the method of tying a bell round the neck of the sheep, which leads the flock, and is, therefore, counted the bell.

About the latter end of the reign of Charles I. it was customary to have races performed in Hyde Park. See the Comedy of the Merry Beggars, or Jovial Crew, written in 1641, in Dodsley's Collection of Old Plays.

Racing was much encouraged by Charles II. after his restoration: he gave public rewards and prizes, and appointed races for his own amusement at Datchet Mead, when he resided at Windsor. But the most distinguished spot for these exercises was Newmarket, which was at first frequented for the purpose of hunting, and seems not to have been destined to be a horse-course till some time before the troubles of the reign of Charles I., when races were discontinued; but they were revived soon after the Restoration. The king attended in person, and established a house for his accommodation, and kept and entered horses in his own name. Instead of bells, a silver bowl or cup, of the value of a hundred guineas, was allotted for a prize; and upon this royal gift the exploits of the successful horse, and his pedigree, were generally engraved. The sum of a hundred guineas is now given in lieu of the silver bowl.

When William III. was advanced to the throne, he not only added to the plates given to different places in the kingdom, but founded an academy for riding. Queen Anne continued the bounty of her predecessors, with the addition of several plates. George I., towards the end of his reign, discontinued the plates, and gave the sum of a hundred guineas in their room.

In the thirteenth year of George II. an act was passed for the suppression of races by ponies, and other small and weak horses, by which all matches for any prize under the value of 50*l.* are prohibited, under a penalty of 200*l.*, to be paid by the owner of each horse running, and 100*l.* by such as advertise the plate; and by which each horse entered to run, if five years old, is obliged to carry ten stone; if six, eleven; and if seven, twelve. It is also ordained, that no person shall run any horse at a course, unless it be his own, nor enter more than one horse for the same plate, upon pain of forfeiting the horses: and also every horse-race must be begun and ended in the same day. Horses may run for the value of 50*l.* with any weight, and at any place. 13 Geo. II. cap. 19. 18 Geo. II. cap. 34. Pennant's Brit. Zool. vol. i. p. 6, &c. Berenger's Hist. and Art of Horfeman-ship, vol. i. p. 185, &c.

We shall here add, that at Newmarket there are two courses, the long and the round: the first is exactly four miles, and about three hundred and eighty yards, *i. e.* seven thousand four hundred and twenty yards. The second is six thousand six hundred and forty yards. Children, the swiftest horse ever known, has run the first course in seven minutes and a half, and the second in six minutes forty seconds; which is at the rate of more than forty-nine feet in a second. But all other horses take up at least seven minutes and fifty seconds in completing the first and longest course, and seven minutes only in the shortest, which is at the rate of more than forty-seven feet in a second, and it is commonly supposed that these courfers cover, at every bound, a space of ground in length about twenty-four English feet.

RACITZA, in *Geography*, a town of Bukovina; 7 miles N. of Czernaucii.

RACK, a small island near the coast of Virginia. N. lat. 37° 19'. W. long. 75° 51'.

RACK, *Lower* and *Upper*, two small islands near the coast

of Virginia; the former in N. lat. 37° 20'. W. long. 75° 50', and the latter in N. lat. 37° 26'. W. long. 75° 45'.

RACK, an engine of torture furnished with cords, &c. for extorting confession from criminals.

The duke of Exeter, constable of the Tower under Henry VI., with the duke of Suffolk, and others, having a design to introduce the civil law into England; for a beginning, the *rack*, or *brake*, allowed in many cases by the civil law, was first brought to the Tower, where it is still preserved; in those days the rack was called the duke of Exeter's daughter. 3 Inst. 35.

It was occasionally used as an engine of state, not of law, more than once in the reign of queen Elizabeth. (Barr. 92. 496.) But when, upon the assassination of Villiers, duke of Buckingham, by Felton, it was proposed in the privy-council to put the assassin to the rack, in order to discover his accomplices; the judges being consulted, declared unanimously, to their own honour, and the honour of the English law, that no such proceeding was allowable by the laws of England. The uncertainty of this punishment, as a test and criterion of truth, was long ago very elegantly pointed out by Tully (pro Sulla, 28.); though he lived in a state in which it was usual to torture slaves, in order to furnish evidence. "Tamen," says he, "illa tormenta gubernat dolor, moderatur natura cujusque tum animi tum corporis, regit quæstor, flectit libido, corrumpit spes, infirmat metus; ut in tot rerum angustiis nihil veritati loci relinquatur."

The marquis Beccaria (ch. 16.), in an exquisite piece of raillery, has proposed this problem, with a gravity and precision that are truly mathematical: "the force of the muscles, and the sensibility of the nerves of an innocent person being given, it is required to find the degree of pain necessary to make him confess himself guilty of a given crime."

RACK, in the *Manège*, a pace in which a horse neither trots nor ambles, but shuffles, as it were, between both.

The racking pace is much the same as the *amble* (which see); only that it is a swifter time, and a shorter tread.

RACK is also a wooden frame, made to hold hay or fodder for cattle. There has lately been much improvement made in the forming of all sorts of racks, both for the stable, cattle-sheds, and field. See CATTLE-sheds, STABLE, and SHEEP-house.

RACK, in *Rigging*, a short thin plank, with holes made through it, containing a number of belaying-pins, used instead of cleats; it is seized to the shrouds, and nailed over the bowsprit or windlafs.—Also, a long shell, containing a number of sheaves, formerly fixed over the bowsprit to lead in the running rigging. At present, wooden saddles, with holes in them, are nailed on the bowsprit for this purpose, being more out of the way, and less liable to be out of order, See SHOT-rack, and SHROUD-rack.

To RACK Wines, &c. is to draw them from off their lees, after their having stood long enough to clear and settle. Hence,

RACK-*Vintage*, is frequently used for the second voyage our wine-merchants used to make into France for racked wines; whence they used to return about the end of December.

RACK-Holders, such tenants as hold their lands under such leases.

RACK-Leases, are such sorts of leases as are granted for one or more lives, at the full rack rents, as in Cornwall, and some other counties. See LEASES of Land.

RACK-Rent, is the full yearly value of land let by lease, payable by tenant for life or years, &c. See RENT.

RACK-

RACK, *Sheep*, a sort of long narrow crib, fixed upon wheels, for containing hay for sheep, having a lid or covering on the top. It is very useful in bad weather, in the winter season, as preventing the hay from being wasted, and admitting the sheep to feed conveniently.

RACKAMA, in *Geography*, a lake of Syria, south of Hella and the ancient Babylon, is about 30 miles long, and flows into the Euphrates.

RACKEBY, a town of Sweden, in West Gothland; 40 miles N.E. of Uddevalla.

RACKET, a kind of bat for striking the ball at tennis; consisting usually of a lattice, or net-work, of cat-gut, strained very tight over a circle of wood, with a handle or shaft of a moderate length.

The word is formed from the French *raquette*, which Menage derives from the Latin *retetta*, a diminutive of *rete*, net; whence also *reticum*, and *reticulum*.

Pasquier observes, that anciently they used no rackets at tennis, but played with the palm of the hand: and hence he conjectures it is that the French call tennis play, *jeu de paume*. He adds, that rackets were not introduced till a little before his time.

RACKET is also a machine which the savages of Canada bind to their feet, to enable them to walk more commodiously over the snow; made much in the manner of a tennis-racket.

Its figure is a lozenge, of which the two obtuse angles are rounded off. It is bound about with very fine thongs of leather, and the meshes of it are much smaller and closer than those of our rackets.

In the middle is fitted a kind of shoe, lined with wool, or hair; to be tied on to the ankle: by which means the feet are prevented from sinking in the snow. Rackets oblige the person to take very long steps, and, as we say, to walk a great pace, to keep them from knocking against each other.

RACKET, in *Geography*, a river of New York, which runs into the St. Lawrence, N. lat. $45^{\circ} 13'$. W. long. $74^{\circ} 42'$.

RACKIBIRN, the name of a small island on the N.W. coast of Ireland, situated near Tiellen head, in the county of Donegal. N. lat. $54^{\circ} 39'$. W. long. $8^{\circ} 44'$.

RACKING, in *Sea Language*, denotes the fastening of two opposite parts of a tackle together, so as that any weighty body suspended by it shall not fall down, although the rope, which forms the tackle, should be loosened by accident or neglect. This expedient is chiefly practised when the boats are hung up to the ship's side in the night, in an open road or bay, lest the rope of the tackle should be untied by the inattention of some of the crew, by which accident the boat might be considerably damaged, and probably lost or dashed to pieces. Falconer.

RACKING Fruit Liquor, the operations of fining and drawing it off. See CYDER.

RACKLIA, in *Geography*, a small rocky island in the Grecian Archipelago, inhabited by two or three poor monks, who take care of a few sheep and goats. N. lat. $36^{\circ} 53'$. E. long. $25^{\circ} 38'$.

RACKNITZ, a town of the duchy of Carinthia; 3 miles S. of Saxenburg.

RACKOON, or **RACCOON**, the *ursus lotor* of Linnæus, in *Zoology*, the name by which we commonly know an American animal, called *coati* by the Brahilians. It is something smaller than the beaver, and is of the shape of the beaver in the body, and its legs are as short as in that creature. The face, cheeks, and chin are white; the upper

part of the body is covered with hair, long, soft, and thick; black at the ends, whitish in the middle, and ash-coloured at the root. Sometimes from this mixture of colour the back appears plainly grey; and Marcgrave mentions another species, which is of a deep yellow or ochre colour.

The head is very like that of the fox in shape; but that the ears are shorter, roundish, and naked, and it has from the forehead to the nose a dusky line. The eyes are large, and surrounded with two broad patches of black; the nose is black and sharp-pointed; its tail is very bushy, and annulated with black. Its feet are each divided into five slender toes; by the help of which it climbs trees as expertly as a monkey, and uses the fore-feet as hands, to reach up its food to its mouth. It is a very cleanly animal; and if there be water near, it always washes its food, be it what it will, before it eats it. It feeds on vegetables, but is also very fond of eggs, and will even seize birds if it can catch them. It is also very fond of sweet things and strong liquors, and will get excessively drunk: at low-water it feeds much on oysters, watching their opening, and with its paw snatching out the fish, and is sometimes caught in the shell. It is very common in the warm and temperate parts of America, in the mountains of Jamaica, and in the isles of Maria in the South sea, and is a creature easily tamed. It is hunted for its skin; the fur, next to that of the beaver, being excellent for making hats. Ray and Pennant.

RACLER, Fr., to scrape, to rasp, or file a hard body. It is said, in derision of a bad performer on the violin, or any other instrument played with a bow, that he scrapes or rasps the strings; because, in fact, he draws a harsh and disagreeable tone from his instrument, which resembles that produced by scraping or filing a hard body. Even good players on the violin sometimes scrape a little in the *forte* parts of their performance. Suppl. to Encycl., 1st edit.

RACLERGUNGE, in *Geography*, a town of Bengal; 50 miles N.W. of Burdwan.

RACONIGI, a town of France, in the department of the Stura, containing four gates, with as many faubourgs, well peopled. The king of Sardinia had a palace here. The police is conducted by fifteen counsellors, from whom two syndics are chosen every four months, who act as bailiffs or mayors of the town. It has two parishes, and several religious houses. The inhabitants are industrious, and much employed in making gauzes and silk stuffs; 6 miles N. of Savigliano.

RACOPILUM, in *Botany, from *ρεκος*, a rent in a garment, or a wrinkle, and *πλος*, a hat or cap, the name of one of Palissot de Beauvois's genera of mosses, whose veil is torn at the side. It ought to be written *Rhacopilum*.*

RACOUBEA, a name of Aublet's, of which we find no explanation. See HOMALUM.

RACOW, *Catechism of*, in *Ecclesiastical History*, a system of theology compiled by the most eminent Socinian doctors, and first published at Racow, or Rakow, in Poland, in the year 1609, with a dedication to our king James I. This catechism, or a translation of it, was committed to the flames in England, in the year 1653, by order of parliament. A new edition of it, corrected and enlarged, was published at Stauropolis, in 1684. The Socinians consider this catechism as the great standard of Socinianism, and an accurate summary of the doctrine of that sect. However, Mosheim observes, that it is, in reality, no more than a collection of the popular tenets of the Socinians, and by no means a just representation of the secret opinions and sentiments of their doctors. Hence he says it never obtained among them the authority of a public confession or rule of faith; and hence the doctors of that sect were authorized to correct and con-

tradit it, and to substitute another form of doctrine in its place. But to this account it has been replied, that it would have been inconsistent with the liberty, for which they argue in the preface to this catechism, to have limited their religious inquiries to this standard; and by treating it as a rule of faith, they would have violated their express declarations, that they dictated to no one, and assumed no authority. *Mosh. Eccl. Hist.* See RAKOW.

RACSON-COMPON, in *Geography*, a mountain of Thibet. N. lat. $31^{\circ} 50'$. E. long. $86^{\circ} 14'$.

RADA, a town of Sweden, in Warmeland; 33 miles N. of Carlstadt.—Also, a town of Sweden, in Warmeland; 35 miles S.E. of Carlstadt.—Also, a town of Sweden, in West Gothland; 5 miles W. of Gothenburg.—Also, a river of Westphalia, which runs into the Ocker, 5 miles N.E. of Goslar.

RADANAGUR, a town of Hindoostan, in Bahar; 32 miles E. of Ramgur.

RADANI, a town of Sweden, in West Gothland; 16 miles N. of Uddevalla.

RADAR, a town of Persia, in the province of Choras; 48 miles N. of Meshid.

RADASALMI, a town of Sweden, in the province of Savolax; 20 miles N.N.W. of Nysslot.

RADAVITZA, a town of Prussia, in the palatinate of Culm; 22 miles E.S.E. of Culm.

RADAUN, a town of Austria; 6 miles W.S.W. of Vienna.

RADAUTZ, or RADENTZ, a town of Bukovina; 22 miles W.S.W. of Saczava.

RADAWAIR, a town of Hindoostan, in Candesh; 14 miles S.W. of Burhanpour.

RADBUZA, a river of Bohemia, that rises in the S.W. part of the circle of Pilsen, and runs into the Miza, near the town of Pilsen.

RADCLIFFE, JOHN, in *Biography*, an eminent and eccentric physician, was born at Wakefield, in Yorkshire, where his father possessed a moderate estate, in the year 1650. He received the rudiments of his classical education at a school in that town; and at the age of 15, was sent to complete his studies at University college, in Oxford. He took his bachelor's degree in arts in 1669, and removed to Lincoln college, where he was elected to a fellowship. Having determined upon the profession of physic, he went through the courses of botany, chemistry, and anatomy, and was distinguished by the rapidity of his attainments in all these pursuits. Nevertheless he did not apply with zeal or industry to the studies of the closet, and recommended himself rather by his vivacity, acuteness, and wit, than by any extraordinary acquisitions in any department of knowledge. In the prosecution of his medical inquiries, he contented himself with looking into the works of Dr. Willis, who was at that time practising in London with much reputation. He was possessed, indeed, of very few books; inasmuch that when Dr. Bathurst, head of Trinity college, asked him once with surprise where his study was? he pointed to a few vials, a skeleton, and a herbal, and said, "Sir, this is Radcliffe's library." He took the degree of master of arts in 1672, and in 1675 he proceeded bachelor of medicine, and immediately began to practise in Oxford. He professed to pay very little regard to the rules which were generally followed, but censured them on many occasions with great freedom and acrimony; a conduct which did not fail to draw upon him the enmity of all the old practitioners. Nevertheless his reputation and his practice rapidly increased; and before he had been two years in the world, he was very generally consulted, even by those of

the highest rank. About this time, in consequence of some witticisms, which he had launched with his accustomed freedom against Dr. Marshall, rector of Lincoln college, the latter unkindly opposed his application for a dispensation for taking holy orders, which the statutes required, if he retained his fellowship, and shewed other tokens of incivility; which induced Radcliffe to resign his fellowship, quit the college, and take lodgings in the town. He continued to practise at Oxford, increasing alike in wealth and reputation, until 1684, having taken the degree of doctor in 1682; and he then determined to remove to London, and settled himself in Bow-street, Covent Garden.

His success in the metropolis was unusually rapid; and doubtless his wit and pleasantry, which rendered him a most entertaining companion, contributed scarcely less than his reputed skill in his profession to forward his progress. In less than a year he was in full practice; and in the second year, he was appointed physician to the princess Anne of Denmark. In 1688, when prince George of Denmark joined the prince of Orange, and the princess retired to Nottingham, in a state of pregnancy, he was pressed by bishop Compton to attend her, in quality of his office; but he excused himself on account of the multiplicity of his patients. After the revolution, he was consulted by king William and the nobility about his court; an honour which he must have owed entirely to his high reputation, for he never shewed any inclination to be a courtier. By his rough independence of spirit and freedom of language, indeed, he ultimately lost all favour at court. In 1699, when king William returned from Holland in a state of severe indisposition, he sent for Radcliffe, and shewing him his swollen ankles, while the rest of his body was emaciated, said, "What think you of these?"—"Why truly," replied the physician, "I would not have your majesty's two legs for your three kingdoms." This freedom was never forgiven by the king, and no intercessions could ever recover his favour towards Radcliffe. In 1694, when queen Mary caught the small-pox, and died, Radcliffe was accused, bishop Burnet says, of negligence and unskilfulness. He soon afterwards lost the favour of princess Anne, by neglecting to obey her call from his too great attachment to the bottle, and another physician was appointed in his place. When queen Anne came to the throne, the earl of Godolphin exerted all his endeavours to reinstate him in his former post of chief physician; but she refused, alleging that Radcliffe would send her word again, "that her ailments were nothing but the vapours." Nevertheless he is said to have been consulted in all cases of emergency, in a private way. In 1703 Dr. Radcliffe had an alarming and dangerous attack of pleurisy, which he neglected, and increased in the outset by drinking a bottle of wine: he had, however, 100 ounces of blood taken from him by Mr. Bernard, the serjeant surgeon; and the next day, in spite of all intreaties, was carried to Kensington. His escape was almost miraculous. The queen asked Mr. Bernard how he did? and when he told her that he was ungovernable, and would observe no rules, she answered, that then nobody had reason to take any thing ill from him, since it was plain he used other people no worse than he used himself. During this illness he made a will, by which he disposed of the greater part of his property for charitable purposes, appropriating particularly several thousand pounds for the relief of sick seamen set on shore. He recovered, however, and continued in full occupation in his profession, increasing in wealth and insolence to the end of his days, and waging a perpetual war with his brethren; who, in their turn, represented him as an active, ingenious, adventuring empiric, whom constant practice

practice had brought at length to some skill in his profession. His caprice in the performance of his professional duties appears to have been unbounded; and many anecdotes are related of his refusal to attend on persons of distinction, if he happened to be engaged in pleasant company, or had any personal pique against the individuals, or if he conceived himself in any way affronted. Thus he set off suddenly for Bath in 1704, while attending the lady of sir John Trevor, because that gentleman sent to Oxford for Dr. Breach to consult with him; which he had done as a compliment to Radcliffe, rather than join any of the London physicians with him. When Mr. Harley was stabbed by Guiscard, Swift complains, that by the caprice of Radcliffe, who would allow none but his own surgeon to be admitted, "he had not been well looked after;" and adds in another place, "Mr. Harley has had an ill surgeon, by the caprice of that puppy Dr. Radcliffe, which kept him back so long." On the other hand, he attended the lady of sir John Holt in a bad illness, with unusual diligence, out of pique to the husband, who was not supposed to be over fond of her. In the last illness of queen Anne, he was sent for to his country-house at Carshalton about noon, by order, as one account affirms, of the privy council; but he returned an answer, that "he had taken physic, and could not come." It has been stated, however, on the other hand, that he was only sent for on this occasion by lady Marlham, without any order from the queen or the council; which is countenanced by the following circumstances. On the 5th of August, four days after the queen's death, a friend of the doctor's moved in the house of commons, that he might be summoned to attend in his place, (Dr. Radcliffe had been elected a member for Buckingham in 1713,) in order to be censured for not attending on her majesty. A letter is preserved, said to have been written by the doctor to one of his friends, on this occasion, in which he says, "I know the nature of attending crowned heads in their last moments too well, to be fond of waiting upon them, without being sent for by a proper authority. You have heard of pardons being signed for physicians before a sovereign's demise; however, ill as I was, I would have went to the queen in a horse-litter, had either her majesty, or those in the commission next to her, commanded me to do so." Whatever was the true state of the case, it is certain that Dr. Radcliffe became so much the object of popular resentment, that he was apprehensive of being assassinated, as appears from a letter addressed by him to Dr. Mead, which is extant. "Nor shall I be at any time from home," he says, "because I have received several letters, which threaten me with being pulled to pieces, if ever I come to London." He survived the queen but three months, and died at Carshalton, on the 11th of November 1714, at the age of 64. It was believed, that the dread which he had of the populace, and the want of company in his retirement, which he did not dare to leave, contributed to accelerate his death. He was carried to Oxford, and buried in St. Mary's church in that city.

It does not appear that Dr. Radcliffe ever attempted to write, and probably he would not have succeeded as an author. He was believed, indeed, to have been very little conversant with books; which made Dr. Garth humorously say, that "for Radcliffe to institute a library, was as if an eunuch should found a seraglio." He was often the subject of the attacks of ridicule from poets and wits, and even was not spared on the stage; having been severely satirized in a piece acted in 1704, soon after a legal dispute with an apothecary, which was attended by the ladies of the court, and in which the passages affronting the doctor were much applauded. Swift, in *Martinus Scriblerus*, and Steele in the

Tatler, levelled their ridicule at the doctor; and the following severe portrait of him was drawn by Dr. Mandeville, in his *Essay on Charity Schools*. "That a man with small skill in physic, and hardly any learning, should by vile arts get into practice, and lay up great wealth, is no mighty wonder; but that he should so deeply work himself into the good opinion of the world as to gain the general esteem of a nation, and establish a reputation beyond all his contemporaries, with no other qualities but a perfect knowledge of mankind, and a capacity of making the most of it, is something extraordinary. If a man arrived to such a height of glory, should be almost distracted with pride, sometimes give his attendance on a servant, or any mean person, for nothing, and at the same time neglect a nobleman that gives exorbitant fees; at other times, refuse to leave his bottle for his business, without any regard to the quality of the persons that sent for him, or the danger they are in:—if he should be surly and morose, affect to be a humourist, treat his patients like dogs, though people of distinction, and value no man but what would deify him, and never call in question the certainty of his oracles:—if he should insult all the world, affront the first nobility, and extend his insolence even to the royal family:—if, to maintain as well as to increase the fame of his sufficiency, he should scorn to consult with his betters on what emergency soever, look down with contempt on the most deserving of his profession, and never confer with any other physician but what will pay homage to his superior genius, creep to his humour, and never approach him but with all the slavish obsequiousness a court flatterer can treat a prince with:—if a man in his life-time should discover, on the one hand, such manifest symptoms of superlative pride, and an insatiable greediness after wealth at the same time; and on the other, no regard to religion, or affection to his kindred, no compassion to the poor, and hardly any humanity to his fellow-creatures:—if he gave no proofs that he loved his country, had a public spirit, or was a lover of arts, of books, or of literature:—what must we judge of his motive, the principle he acted from, when after his death we find that he has left a trifle among his relations, who stood in need of it, and an immense treasure to an university that did not want it."

Whatever may be the motives of the endowers of splendid institutions for the public use, the nation is at all events benefited for ages, by such noble establishments as the library and infirmary which he founded at Oxford, and which bear his name. He also endowed two travelling fellowships, with an annual income of 300*l.* attached to each. He had previously caused the beautiful east window, over the altar, in University college, to be put up at his own expence; and likewise given the money, which was paid for the erection of the master's lodge there, making one side of the eastern quadrangle. He was certainly avaricious to the extent almost of spunging, and never could be induced to pay bills without much following and importunity. A piece of waggery would sometimes conquer this disposition. A pavior, after long and fruitless attempts, once caught him just getting out of his chariot, at his own door, in Bloomsbury square, and set upon him. "Why, you rascal," said the doctor, "do you pretend to be paid for such a piece of work? Why, you have spoiled my pavement, and then covered it over with earth to hide your bad work."—"Doctor," said the pavior, "mine is not the only bad work the earth hides."—"You dog you," said the doctor, "are you a wit? You must be poor; come in:" and he paid him. He told Dr. Mead, that the great secret by which he might make his fortune was to "use all mankind ill." Dr. Mead, however, adopted the

contrary axiom, and succeeded even beyond his adviser. Notwithstanding that Radcliffe seems to have literally practised this principle, in his dealings both with his patients and his brethren; and notwithstanding the severe accusations of ignorance and empiricism, which were every where levelled against him; the universal reputation, which he acquired and maintained, seems to sanction the testimony of Dr. Mead, that "he was deservedly at the head of his profession, on account of his great medical penetration and experience." See Atterbury's *Epistolary Correspondence*. The *Richardsoniana*. Pope's Works, vol. vii. Swift's Works, vol. xix. Hutchinson's *Biographia Medica*.

RADDELE, in *Geography*, a town of Ceylon, on the east coast; 5 miles N.E. of Trincolli.

RADDINSDORP, a town of the duchy of Holstein; 6 miles E.S.E. of Eutyn.

RADDLE, in *Agriculture*, a red ochre of iron, which, according to Dr. Darwin, has been found useful as a manure in the northern parts of Staffordshire. Its properties have not, however, been yet chemically examined as they relate to manure. See REDDLE.

RADEBURG, in *Geography*, a town of Saxony, in the margraviate of Meissen; 10 miles N.E. of Dresden. N. lat. $51^{\circ} 8'$. E. long. $13^{\circ} 53'$.

RADECHAU, a town of Bohemia, in the circle of Koniggratz; 9 miles S.E. of Trautenau.

RADEGATZ, a town of Germany, in the principality of Anhalt-Deßau; 13 miles S.S.W. of Deßau.

RADEGURRY, a town of Hindoostan, in Canara; 24 miles S.S.E. of Mangalore.

RADENTHAL, a town of the duchy of Carinthia; 13 miles E. of Saxenburg.

RADERAN, a town of Bohemia, in the circle of Kaurzim; 3 miles N.E. of Kaurzim.

RADERMACHIA, in *Botany*, a name originally given to the Bread-fruit, (see *ARTOCARPUS*.) by Thunberg, in honour of one of his great patrons, Joachim Cornelius Matthew Radermacher, a member of the Dutch council, and President of the Society of Sciences, at Batavia. The author, in his *Nova Genera*, p. 25, represents this gentleman as a most distinguished Mæcenas, and encourager of Natural History. Nevertheless, the above name has, by common consent, given way to the expressive one of Forster, *Artocarpus*, which is precisely synonymous with Bread-fruit.

RADERSBERG, in *Geography*, a town of Germany, in the principality of Culmbach; 7 miles E. of Bayreuth.

RADES, a town of Tunis, on the N.E. coast; 5 miles S.E. of Tunis.

RADESCHÉ, or RATSCHACH, a town of Lower Carniola, on the Save; 10 miles N.W. of Gurckfeld.

RADHA, in *Mythology*, is the name of the consort of the Hindoo deity Krishna. As Krishna was an avatara, or incarnation of Vishnu, so Radha is understood to be similarly an avatara of Vishnu's consort Lakshmi; thus incarnated to accompany her lord in this, his most splendid terrestrial manifestation. Under the articles KRISHNA and LAKSHMI some notice will be found on the subject of this. Radha is seen very frequently portrayed and alluded to in the paintings and writings of India: Krishna is, indeed, seldom seen without her. She is represented of perfect beauty, and is warmly celebrated in the amatory poetries of Hindoostan. In the elegant work of Jayadeva, entitled *Gita Govinda*, a pastoral drama exhibiting the loves of Krishna and Radha, the lovely nymph is thus described after a quarrel with her frolicsome and fickle lord, in the morning after the night of reconciliation, when affliction ceased, and ecstasy crowned the recol-

lection of past sorrows. "In the morning she arose, disarrayed, and her eyes betrayed a night without slumber, when the yellow-robed god, who gazed on her with transport, thus, in his heavenly mind, meditated on her charms: 'Though her locks be diffused at random; though the lustre of her lips be faded; though her garland and zone be fallen from their enchanting stations; and though she lides their places with her hands, looking towards me with bashful silence; yet, even thus disarrayed, she fills me with ecstatic delight.' But Radha, preparing to array herself before the company of nymphs could see her confusion, spake thus with exultation to her obsequious lover.

'Place, O son of Yadu! with fingers cooler than sandal wood, place a circlet of musk on this breast, which resembles a vase of consecrated water, crowned with fresh leaves, and fixed near a vernal bower to propitiate the god of love. Place, my darling! the glossy powder, which would make the blackest bee envious, on this eye, whose glances are keener than arrows darted by the husband of Reti. (See RETI.) Fix, O accomplished youth! the two gems, which form part of love's chain, in these ears, whence the antelopes of thine eyes may run downwards and sport at pleasure. Place now a fresh circlet of musk, black as the lunar spots, on the moon of my forehead; and mix gay flowers on my tresses with peacock's feathers, in graceful order, that they may wave like the banners of Kama. Now replace, O tender hearted! the loofe ornaments of my vesture; and refix the golden bells of my girdle on their destined station, which resembles those hills where the god with five shafts, who destroyed Sambara, keeps his elephant ready for battle.' While she spake, the heart of Yadava triumphed; and obeying her sportive behests, he placed musky spots on her bosom and forehead; dyed her temples with radiant hues: embellished her eyes with additional blackness; decked her braided hair, and her neck, with fresh garlands; and tied on her wrists the loosened bracelets, on her ankles the beamy rings, and round her waist the zone of bells, that sounded with ravishing melody."

But we must recollect, says the author of the Hindu Pantheon, whence this article is chiefly taken, that the seemingly amorous conflicts of these ardent lovers are mere mystical descriptions of "the reciprocal attraction between the divine goodness and the human soul." This is the emblematical theology that Pythagoras admired and adopted; that the Sufi poets, Hafez, Sadi, and many others among the Persians, and Solomon also, in his fine Song, so beautifully inculcates. Like the enthusiasts of other days, and in a manner not easily comprehended by the unenlightened, nor believed by them to be permanently chaste, however innocent its commencement, "they profess eager desire, but without carnal affection; and circulate the cup, but no material goblet: in their sect, all things are spiritual, all is mystery within mystery." See sir W. Jones's admirable Essay on the Mythical Poetry of the Persians and Hindoos, in the third volume of the Asiatic Researches, in which a translation of the *Gita Govinda* of Jayadeva is introduced. Under the article JAYADEVA of this work is a brief notice of his poem; and under MAHESA is an extract from it, descriptive of the persons and loves of this interesting couple. (See also PRABHA.) The reader desirous of seeing what has been said and believed on the curious subject of mystical or emblematical theology, may consult our articles under MYSTERY, MYSTICS, and those thence referred to.

Returning to Radha, we have to observe that among the sect of Gokalaithia (see *SECTS of Hindoos*) she is deemed a personification of religion, and sometimes called *Rukmini*.

(See that article.) There is a sect said to worship her exclusively, and called Radha-ballabhi: they consider her as the Sakti, or active power of Vishnu or Krishna. (See SAKTI.) The followers of this sect have ascribed to them the singular practice of making their own wives personate Radha, and of presenting to or through them the oblations propitiating the goddess, or Lakshmi, of whom, as before said, she is an incarnation. There is no end to the whimsicalities in the modes of human worship, to give them no harsher name, wherever, to use an oriental expression, we suffer our necks to slip out of the collar of reason. Thus in India, as hath been the case in other countries, there is, with several sects, a *right-handed* and a *left-handed* mode of worship; one meaning a decent, the other an indecent mode. Those among the sect in question, who follow the left-handed path, require their wives to be naked, when attending them at their devotional abominations. She is sometimes called Radhika, and Krishna, Radhikeswara, or lord of Radhika; and sometimes the name of Kantanati is given both to her and Rukmeni. See RUKMENI and YONI.

In Radha may be recognized the Grecian Juno, and of course in her husband Krishna, or Vishnu, the amorous Jove of that imitative race. On this point we shall quote a paragraph from the Edinburgh Review, N^o xxxiv.

"We translate a passage from the Purana, entitled Brahma Vaivartica, to demonstrate the identity of character ascribed to Jupiter and Vishnu; only premising, that in conformity to the peculiar tenets of its author, Vishnu is here styled Krishna, and his goddesses, Rādhā. Gangā (the Ganges) was originally a nymph of wonderful beauty, who inhabited Paradise. She became enamoured of Krishna, and, concealing her face with her robe, stood immovable in his presence, her eyes fixed on his radiant countenance. The jealousy of Rādhā (Juno) was excited. Followed by her innumerable attendants, she repaired to the presence of the god, and seated herself on her throne of gems. The timid Gangā trembled at her aspect, and dissolved with terror. The goddess speaks: "Who is this nymph, lord of the universe, who, with half concealed visage, and eyes sparkling desire, thus gazes on thy sacred person? This is not the first time the skies have witnessed the infidelity of their lord. When I detected thee dallying in a grove of sandal with Viraja, the figure of a quadruped concealed thy shame, and she was changed into a river. Still pursued by thee she became the mother of the mighty ocean. The same forest was the scene of thy amours with the nymph Sobhā, (beauty). Again thou assumedst the form of an animal; whilst her spirit fled to the moon, and thou dividest her body amongst gems, flowers, and black-eyed damsels. The woods of Vrindavan afforded thee a retreat with the shepherdess Prabha (lustre.) On my arrival, her spirit transmigrated to the solar orb; of her body thou madest a distribution: the god of fire obtained a part; and some, as gold, give brightness to the crowns of the kings of the earth. When I found thee, unexpectedly, on a bed of vernal buds, reclined in company with the fair Xamā (patience), alarmed at my voice, thou gatheredst as they lay dispersed, thy yellow robes, thy lyre, thy necklace of flowers, and thy crest of gems. Thee I forgave when thou bestowedst a portion of her body on the pious anchoress, a portion on the sick, and a portion on the studious."

Such of our readers as have obtained a share in the latter portion, may, in the endeavour to expound this solar allegory, be repaid perhaps for their pains; in perusing the Gita Govinda and the article in which it is comprised, above referred to, they assuredly will.

RADHIKA, a name of Radha, consort of the Hin-

do deity Krishna, as sufficiently noticed under those articles.

RADHOST, in *Geography*, a mountain of Moravia, in the circle of Prerau; 12 miles E. of Meferitch.

RADHUA, a mountain of Arabia; 30 miles W. of Medina.

RADIÆUS, in *Anatomy*, an epithet applied to parts about the radius, and equivalent to *radialis*; which see.

RADIAL CURVES. See CURVES.

RADIALIS, in *Anatomy*, a name given to parts in the fore-arm, situated near the radius. The adjective *radial* is also employed to denote the edge, surface, or aspect of any part, which is towards the radius; and in this way, with the term *ulnar*, affords the means of describing the organs much more accurately and intelligibly, than the indefinite expressions of *outer* and *inner*, which vary constantly in the changing attitudes of the limb.

RADIALIS Arteria, is the artery of the wrist, in which the pulse is commonly felt. See ARTERY.

RADIALIS Carpi Extensor, Longior & Brevior. See CARPI.

RADIALIS Carpi Flexor. See CARPI.

RADIALIS Externus, Longior & Brevior, synonyms of the extensores carpi radiales, longior & brevior. See CARPI.

RADIALIS Internus, a synonym of the flexor carpi radialis. See CARPI.

RADIALIS Nervus. The large nerve which goes behind the humerus, between two heads of the triceps, is called radial by some anatomists: others give this name to the nerve which lies parallel to and over the brachial artery. The first of these is called also the muscular spiral nerve, the second the median. See NERVE.

RADIALIS Vena, the vein corresponding to the radial artery. See VEIN.

RADIANT HEAT. See HEAT.

RADIANT Point, or Radiating Point, is any point of a visible object, whence rays proceed.

Every radiant point diffuses innumerable rays all round; but only those radiants are visible, from which right lines may be drawn to the pupil; because the rays are all right lines.

All the rays proceeding from the same radiant continually diverge; the crystalline collects or reunites them again.

RADIATED, in *Botany*, an epithet applied to round flat flowers, consisting of a disk, and a single row of longish pointed leaves, ranged all around it in manner of rays, or spokes.

Radiated flowers are properly such as have several semi-florets set round a disk, so as to resemble a radiant star: such are daisies, chamomile-flowers, sun-flowers, &c. These are sometimes also called *radiated discous flowers*.

A radiated flower has two parts; its middle part, which is called the disk, and which is wholly made up of floscules; and the other part, which is called the circle or border, which is wholly made up of semi-floscules, or else of plain flat leaves; but that is less common. The floscules and semi-floscules both usually adhere to the embryos, and to the thalamus of the flower, being contained in one general cup. These embryos finally ripen into seeds; sometimes furnished with down, sometimes with foliaceous heads, and sometimes without either, and sometimes margined. Of these seeds some are wrapped round with a kind of case or capsule, others are separated from one another by small perpendicular leaves.

RADIATED Leaf. See LEAF.

The word is also used in speaking of medals, and in heraldry,

heraldry, where the ancient crowns are called radiated crowns, *coronæ radiatæ*. See CROWN.

RADIATION, in *Physics*, the action of a body diffusing rays of light as from a centre.

Every visible body is a radiating body; it being only by means of its rays that it affects the eye.

The surface of a radiating body may be conceived as consisting of radiant points.

RADIATION, *Place of*. See PLACE.

RADIATION, or *Irradiation*, is also used by some authors to express the manner of the motion of the animal spirits; on a supposition that they are diffused from the brain towards all parts of the body, through the little canals of the nerves, as light is from a lucid body. But in lieu of a radiation, the moderns rather incline to the opinion of the circulation of the spirits.

RADICAL, **RADICALIS**, in *Physic*, &c. something serving as a basis or foundation; or which, like a *root*, is the source or principle whence any thing arises.

The schools talk much of a radical moisture inherent in the seeds of all animals, which nourishes and preserves the vital heat or flame, as oil does a lamp; and which, when exhausted, life is extinguished.

Dr. Quincy observes, that this radical moisture is a mere climera; unless we thereby mean the mass of blood, which is the promptuary whence all the other juices and humours are derived; and which, while it circulates, sustains life, &c.

In grammar, we use the term, radical words, for roots and primitives; in opposition to compounds and derivatives. In the Hebrew language, the letters of the alphabet are divided into *radical* and *servile*. The first constitute primitive or original words, which, by a significant metaphor, are called roots, *שורשים*. All the 22 letters of the alphabet may be radicals; i. e. primitive words may consist of any of these letters; but the following 11 letters properly claim this title, because they can never be *serviles*; viz. א, ב, ג, ד, ה, ו, ז, ח, ט, י, כ. Of whatever letters any word consists, it must at least contain one of a radical character. (See ROOT.) For an account of the servile letters, see *SERVILE*.

RADICAL Numbers, *Numeri Radicales*, in the Italian music, are 2, 3, 4, 5, 6, 7, 8, 9, and sometimes 10, which are often met with in musical compositions, to denote the accords of the thorough basses: 2 stands for the second and its duplicates; 3 for the third; 4 for the fourth, &c.

RADICAL Leaf, among *Botanists*. See LEAF.

RADICAL Sign, in *Algebra*, the sign or character of the root of a quantity.

✓ is the character of radicality, and expresses the square root;

$\sqrt[3]{}$ the cube root, &c.

RADICANS, in *Botany*, rooting, a term applied to a stem which throws out fibres as it extends itself, whether those fibres be true radicles, by which the plant imbibes nourishment, and is generally increased; or whether they serve only for the support of the stem against walls, rocks, or neighbouring trees. Of the first kind, the Strawberry affords a familiar example; of the latter, the Ivy, the Virginian Creeper (*Hedera*, or rather *Vitis*, *quinquefolia*), and the *Bignonia radicans*, are instances.

RADICATION, the action by which plants take root, or shoot out roots.

The French Royal Academy of Sciences have made a great number of curious observations on the germination and radication of plants.

RADICLE, in *Agriculture*, that part of the seeds of plants which, upon vegetating, becomes their nascent roots.

It is, in fact, the main organ or medium of nutrition, and the means by which food is imbibed or drank up from the surrounding soil or earth. The radicles, together with the leaves, therefore, constitute the *absorbent* organ of plants. See *RADICULA*, and *ROOT*.

RADICOFANI, in *Geography*, a town of Etruria, near which are two castles, one built by Didier, last king of the Lombards, and the other by Cosimo I.; 55 miles S. of Florence.

RADICONDOLI, a town of Etruria; 24 miles N.E. of Florence.

RADICULA, in *Botany* and *Vegetable Physiology*, the radicle, or fibre of the root. (See *ROOT*.) This term is used by Dillenius, in his *Nova Genera*, 121. t. 6, as a generic name, for a set of plants referred by Linnæus to *SISYMBRIUM*. See that article.

RADII Pronator Quadratus, in *Anatomy*, a muscle of the fore-arm. See *PRONATOR*.

RADII Pronator Teres. See *PRONATOR*.

RADII Supinator Brevis, { muscles of the fore-arm. See

RADII Supinator Longus, } *SUPINATOR*.

RADII Pinnarum, in *Ichthyology*, the little slender bones supporting the membrane, forming the fins in fishes, and called by Artedi *ossicula radiata pinnarum*, from their running from the base to the summit in the form of rays. See *FIN*, and *Anatomy of FISH*.

RADIMPOUR, in *Geography*. See *RADUNPOUR*.

RADIOLA, in *Botany*, so called by Dillenius, because the cells of the ripe capsule spread like the rays of a little wheel. The plant having been referred by Linnæus to the genus *Linum*, the above became its specific name; but it is now restored to the rank of a genus by the late professor Gmelin of Gottingen, as well as by the author of *Flora Britannica*.—Dill. Nov. Gen. 126. t. 7. Gmel. Syst. Nat. Linn. v. 2. 289. Sm. Fl. Brit. 201. Prod. Fl. Græc. Sibth. v. 1. 110. Ait. Hort. Kew. v. 1. 282.—Class and order, *Tetrandria Tetragynia*. Nat. Ord. *Gruinales*, Linn. *Caryophyllaceæ*, Juss.

Gen. Ch. Cal. Perianth inferior, of one leaf, cut about half down into four equal, permanent, wedge-shaped segments, each of which is three-cleft. Cor. Petals four, obovate, about the length of the calyx, alternate, with its principal segments. Stam. Filaments four, awl-shaped, erect, the length of the calyx; anthers roundish, of two lobes. Pist. Germen superior, roundish, with four grooves; styles four, terminal, very short; stigmas capitate. Peric. Capsule roundish, bluntly five-sided, of eight cells and eight valves. Seeds solitary, elliptical, compressed, very smooth.

Ess. Ch. Calyx in many segments. Petals four. Capsule superior, with eight valves and eight cells. Seeds solitary.

1. *R. millegrana*. Thyme-leaved Flax-seed. Engl. Bot. t. 893. (*R. vulgaris serpyllifolia*; Dill. in Raii Syn. 345. t. 15. f. 3. Jacob. Faverh. 92. *Linum Radiola*; Linn. Sp. Pl. 402. Fl. Dan. t. 178. *Linocarpum Serpyllifolium*, multicaule et multiflorum; Mich. Gen. 23. t. 21. *Millegrana minima*; Raii Syn. ed. 2. 207. Ger. Em. 569. *Chamælinum vulgare*; Vaill. Paris. t. 4. f. 6.)—Native of sandy ground, overflowed by clean fresh water, throughout Europe, flowering in July and August; but not a very general English plant. The root is annual, small, and fibrous. Stem an inch or two high, repeatedly forked, corymbose, spreading, leafy, round, nearly smooth, many-flowered, often reddish. Leaves opposite, sessile, ovate, entire, smooth, scarcely a quarter of an inch long. Flowers small, white, on short, simple, solitary stalks from the forks of the stem.—Gmelin has erred considerably in the

the generic character and name, as well as in his reference to Linnæus. The *calyx* is many-cleft, not composed of four distinct leaves; the plant has hardly any thing of the aspect of a *Linum*, and therefore cannot properly be called *linoides*; neither has it been published as a genus, under the name of *Radiola*, by Linnæus, as Gmelin's reference to the 12th edition of Syst. Nat. indicates.

RADIOMETER, a name which some writers give to the *radius astronomicus*, or Jacob's staff. See **FORE-STAFF**.

RADISH, in *Botany*. (See **RAPHANUS**.) The radish is much grown, according to the author of the Agricultural Survey of the County of Kent, on the best rich loamy soils of the Isle of Thanet, and in East Kent, for the supply of the London feedmen. The sorts usually cultivated for this use are, the early short top, the salmon, and the turnip-rooted radish.

The land for the growth of this sort of crop should be in a fine state of preparation, by being ploughed to a great depth in the early part of the winter, and broken well down by harrowing, so as to render it perfectly clean from weeds, being previously filled with well reduced manure. The ground being brought into this fine condition, the seed is sown on furrows about ten inches apart, in a dry time in the month of March, about two or three gallons *per* acre. And as soon as the plants appear, every other row is cut up with a horse-hoe, leaving the rows twenty inches apart. When the plants get two or three rough leaves, they are hoed out in rows, and are then kept clean by repeated horse and hand-hoeing, when necessary, leaving the plants at about eighteen inches distance. It is added, in the above Report, that the crop is seldom fit to reap till October, and sometimes is out in the fields till Christmas, without receiving injury from wet weather; it being necessary that it should have much rain to rot the pods, that it may thrash well. In respect to the produce, it is from eight to twenty-four bushels *per* acre: and it is sold to the London feedmen, who send it to all parts of the kingdom for retailing to the gardeners.

It is probable that this sort of crop might be grown in many other districts near the metropolis, or other large towns, with equal success, where the soil is of a rich loamy nature, as it is very easy in its culture, and requires but little labour or trouble. As it is necessary for it to remain out such a length of time, however, it will be proper, especially in wet seasons, to keep the stems from falling too much upon the ground, as they and the seed may be injured by being too much in contact with it. If kept up in this way, the stalks, seed-husks, and other offal parts, may also form a good cut food for some sorts of live-stock, as is the case with some other similar sorts of crops.

RADISH, *Horse*. See **COCHLEARIA Armoracia**.

RADIUS, in *Anatomy*, that bone of the fore-arm which extends from the humerus to the wrist, in the line carried from the external condyle of the former bone to the thumb. See **EXTREMITIES**.

RADIUS, *Dislocations and Fractures of*. See **FRAC-TURE** and **LUXATION**.

RADIUS, in *Botany and Vegetable Physiology*, means the aggregate marginal florets, of compound flowers, each generally of an oblong form, and all spreading from the centre, or disk, like rays. Such are the white florets of the Daisy, and blue, purple or red ones, for the most part, of the *Aster*. The usual shape of the limb or border of such florets is ligulate; either linear, or elliptical; rarely, as in *Achillea*, short and roundish; the extremity having three or five teeth. In some compound flowers the *radius* consists of tubular florets, as in *Centaurea*; and those are neuter, destitute of organs of fructification. The ligulate radiant florets above-mentioned

are either female, producing perfect seed; or they are abortive, with more or less imperfect traces of a pistil. Many of them have no signs of a style or stigma, but none is without so much of a germen, as serves for the basis, that supports the petal itself.

A radius is occasionally assumed by some flowers, naturally destitute of one, as in the genus *Bidens*, each species of which, by such an acquisition, becomes a *Coreopsis*, and changes its order in the *Syngenesia*, from *Polygamia aequalis*, to *P. superflua*. This change is an approach towards a double flower, in that class; being a transformation of a certain number of the perfect, or united, florets into female ones. If such a transformation be total, and all the tubular florets become ligulate, the whole flower is double, and unproductive of seed, like the double Chamomile.

RADIUS, *Ray*, in *Geometry*, the semidiameter of a circle; or a right line drawn from the centre to the circumference.

The word is derived from the Greek *ῥαδος*, *rad*. Peta uses the word radius, for a furrow.

The radius is also called, especially in trigonometry, *sinus totus*; the whole sine.

It is implied in the definition of a circle, and it is apparent from its construction, that all the radii of the same circle are equal.

RADIUS, in the *Higher Geometry*, *Radius of the evolute*, *Radius curvæ*, or *Radius osculi*, called also the radius of concavity and the radius of curvature, is a right line representing a thread, by whose evolution from off the curve on which it was wound, the curve is formed: or it is the radius of a circle that has the same curvature in a given point of a curve with that of the curve in that point. See **CURVATURE** and **EVOLUTE**, under which articles the method of finding this radius may be seen.

RADIUS Astronomicus, an instrument usually called Jacob's staff, the cross-staff, or fore-staff.

RADIUS, in *Optics*. See **RAY**.

RADIUS, in *Mechanics*, is applied to the spokes of a wheel; because issuing like rays from its centre.

RADIUS Vector, is also used for a right line drawn from the centre of force in any curve in which a body is supposed to move by a centripetal force, to that point of the curve where the body is supposed to be. See **CENTRAL Force**.

RADIUS, among the Romans, a name given to the iron rod with which the boys rolled the trochus.

RADIUS Articulatus, in *Natural History*, a name given by Mellius, Gmelin, and some other authors, to a kind of figured fossils, of which there are a great many very different species, some of which have been described by authors among the belemnites, under the names of *alveoli belemnitarum*. Mr. Gmelin, who has taken great pains to inform himself, as well of the nature and figure of these stones, from the subjects themselves, as of their history, and the various accounts of them from other authors, observes, that the place where they are most frequent is Sweden, and that there they are no where so common as in the isle of Oeland. Volkman figures some also which he found in Silesia, and Helwing others which he collected in Prussia: he also found great numbers of them himself in Russia.

They are usually immersed in lime-stone, and though at first sight they may all appear alike, yet, on a careful examination, they will be found to differ very greatly. The most obvious general distinction, established by Gmelin, is that some of them are straight, and others crooked. The straight ones may be divided into two genera. The first of these comprehend, according to this gentleman, two specks; the first smooth, and with a converging alveolus.

The

The regular and nice configuration of these bodies shews very plainly that they cannot be of mineral origin; but the several patellæ of which each is composed, the siphunculus of communication, obvious in several, and the shelly matter yet found remaining on many, prove them to have been once shell-fish of the univalve or tubular concamerated kind; the description of which, so far as it can be gathered from these remains, must have been this. The shell must have been either cylindric or conic in figure, of a smooth surface, and divided into several chambers or cells; but this so that the septa which form the concamerations are not continued and whole, but in some part of the periphery are cut in, in the shape of a crescent. Through these crescents, which, standing all together, make a continued canal, there has passed another shelly body of a cylindric or conic figure, also divided into concamerations, and that in such a manner, that the septa which form the cells are pierced with a small aperture on one side, which grows gradually smaller as the shell extends in length; and finally, through these apertures, in the concamerations, there passes another shell pointed at the end, and, like the rest, divided into its concamerations, and pierces along its middle with a siphunculus. Mem. Acad. Petrop. vol. iii. p. 263.

This shell is, therefore, a compages of three shelly bodies, enclosed one within another; and, it must be supposed, in order to carry an analogy with other shell-fish, these three shelly bodies have communication with one another, by means of certain slips or perforations. The communication of these, one with another, seems all evident, from their being all found in their fossile state, filled with the same stony matter; this has, doubtless, been all received in at the siphunculus of the inner shell, and thence has been thrown into the second, and from this into the third shell, so as to fill up all the concamerations of the outer, as well as of the inner parts. This must have been the case with these; and the several various species that are at this day found fossile, must have owed their origin to as many different species of the shells. The crooked and twisted, or wreathed kinds, which have the siphunculus usually placed near the side, greatly approach in their structure to some of the cornu ammonis.

RADIX, in *Botany and Vegetable Physiology*. See **ROOT**.

RADIX is used among some anatomists for the sole of the foot.

RADIX Carlo Sancto; this root is found in temperate soils, in Mechoacan, a province of America. Its bark is easily separated from it, is of an aromatic smell, and of a bitter and somewhat acrid taste. The root itself consists of very slender fibrils, which are easily separated from each other. The bark is accounted sudorific, and corroborates the stomach and gums: if chewed, it procures an agreeable breath. It is good for scurvy, catarrhs, epilepsies, hastening deliveries, and removing hernias, and the small-pox, if taken either in powder or in the form of a decoction. The Spaniards have called it by the name of St. Charles, on account of its uncommon virtues.

RADIX Entrochorum, the root of the entrochi, a name given by some authors to a fossile substance, usually found among the entrochi, and seeming to have been the basis from which they have grown. It is plainly a part of the *stella marina arborefcens* petrified, as those stones also are. This fossile is rarely found whole, but the fragments of it are very common. When entire, it is about the size of a walnut; the top of it being flat, and in some degree resembling the end of an entrochus, with a central hollow, but not having the least appearance of the rays of those stones. These fossils, though

not properly judged of as to their origin, have yet been described by a great number of authors. Agricola, in particular, compares the form of them to a wheel. The body of this kind well resembles indeed the nave of a wheel, the shape of it being conical toward one end, till you come to the top, and then a little flattened, with a hole in it. There is also a like hole in the opposite broad end of the same fossil, seeming fit for an axle to pass through; and there are five hollow stilts, or feet, issuing sideways, at equal distances from the broad bottom, and equally carried on in the same direction, so as not amiss to represent the spokes. At the end of each of these rays or spokes, there is a hollow, of the same nature with those in the middle of the common entrochi, but this is cut across, by a seam, or streak of the same stone, which passes directly over its centre, and covers about a third part of it; this goes no farther than the mouth of the hole, but it cuts it into two, and shews it in the form of two eyes. These radii or spokes are very seldom found so perfect as here described. Lister mentions them as being formed like crescents at the end, which may very easily happen from the breaking off a part of the terminating portion. Phil. Trans. N^o 129.

RADIX Alba, a word used by Dioscorides, to express the root of the dracunculus.

RADIX, among *Grammarians*. See **RADICAL**, and **ROOT**.

RADIX, in *Mathematics*, the same as root; but used in a different sense by different authors: we say the *root* of an equation, but the *radix* of a system of logarithms, the *radix* of a series, the *radix* of notation, &c. meaning in all these cases the fundamental quantity on which the system is constructed, or that whence it has been derived, or that by means of which all other things of a like kind are compared.

RADIX of a System of Logarithms, is that number which is involved to the power denoted by the logarithm, is equal to that number. Thus, under the article **LOGARITHMS** it is shewn, that if $r^x = a$, then x is the logarithm of a , and r is called the radix of the system. This radix in the common or Briggs's logarithms, is 10, and in the Neperian or hyperbolic logarithms, it is 2.71828128, &c. and generally the radix of any system of logarithms, is that number whose logarithm in that system is unity.

RADIX of a System of Notation, is that number which indicates the local value of the figures, and is in all systems represented by a unit and cipher (10), which is *ten* in the common system, *two* in the binary system, *three* in the ternary, *twelve* in the duodenary, and so on. See **NOTATION**.

RADIX of a Series is used, by some authors, as a term of comparison between any finite function, and its expansion or development: thus, the radix

$$\text{of } 1 - r + r^2 - r^3 + r^4 \quad \&c. \text{ is } \frac{1}{1+r}$$

$$\text{of } 1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} \quad \&c. \text{ is } \frac{1}{1+\frac{1}{2}}$$

$$\text{of } 1 - 1 + 1 - 1 + 1 \quad \&c. \text{ is } \frac{1}{1+1}$$

$$\text{of } 1 - 2 + 4 - 8 + 16 \quad \&c. \text{ is } \frac{1}{1+2}$$

$$\text{of } \frac{1}{2} - \frac{1}{4} + \frac{1}{8} - \frac{1}{16} + \frac{1}{32} \quad \&c. \text{ is } \frac{1}{2+1}$$

$$\text{of } 1 + x + x^2 + x^3 + x^4 \quad \&c. \text{ is } \frac{1}{1+x}$$

of $1 + 2x + 3x^2 + 4x^3 + 5x^4$ &c. is $\frac{1}{(1-x)^2}$

of $1 + \frac{x^2}{2} + \frac{3x^4}{8} + \frac{5x^6}{16} +$ &c. $\sqrt{\frac{1}{1-x}}$

See Dr. Hutton's *Tracts*, vol. i. p. 9. See also our article *SERIES*.

RAD-KNIGHTS. See *REDMANS*.

RADL, in *Geography*, a mountain of Stiria; eight miles S.S.W. of Landšperg.

RADLER SEE, a lake of Carinthia; six miles N. of Saxenburg.

RADLSTEIN, a town of the duchy of Carnolia; six miles W. of Landštrafs.

RADLSTHAL, a town of Austria; nine miles E. of Krottau.

RADMANS. See *REDMANS*.

RADMANSO, in *Geography*, a small island in the Baltic, near the coast of Sweden. N. lat. $59^{\circ} 45'$. E. long. $18^{\circ} 44'$.

RADNAGUR, a town of Bengal; 32 miles S. of Burdwan.

RADNITZ, a town of Bohemia, in the circle of Pilsen; 10 miles N.E. of Pilsen.

RADNOR, NEW, or *Maes-Yfed*, a borough and market-town in the cwmwd of Swydd Wynogion, Cantref y Clawdd, (now called the liberties of the town of New Radnor,) county of Radnor, South Wales, is situated near the river Somergill, at the distance of seven miles N.W. from Kingston, and 156 miles W.N.W. from London. In remote times, this town was a place of great importance, as appears from its having given name to the county, but it has now dwindled into comparative poverty and insignificance. Caradog informs us, that about the year 990, Meredydd ab Owain destroyed Radnor, in a ferocious contest with his nephew, who had been assisting the English to ravage South Wales. It recovered, however, from this disaster, and continued to flourish till the union of Wales with England, when it began to decline, in consequence of its ceasing to be fortified and garrisoned as a frontier town. Before that period, it was surrounded by a lofty wall, and a deep moat, some remains of which are distinctly visible on the west and south sides. The walls, when standing, are traditionally said to have been of great height. The area inclosed by them was an oblong square, containing about twenty-six acres of ground, laid out into three longitudinal streets, which were intersected by five transverse ones. Of these at present several have no buildings; and others are only foot paths. But though thus decayed, Radnor still preserves its privileges as a borough. The corporation consists of a bailiff, twenty-five capital burgesses, two aldermen, a recorder, a coroner, a town-clerk, and other inferior officers. The bailiff and aldermen are chosen annually from among the capital burgesses, and are justices of the peace. The bailiff of the preceding year is also a justice of the peace; and there are besides three additional persons nominated out of the capital burgesses, who are invested with similar authority. The district over which they preside, and supersede the jurisdiction of the county magistrates, is considerable; comprehending a circle round the town nearly ten miles in diameter. The bailiff's courts and the petty sessions are regularly held every Monday, when the bailiff, aldermen, and town-clerk attend to transact business relating to the borough, and have power to determine all suits for sums under forty shillings. The quarter-sessions for the borough are held on the Mondays after the county quarter-sessions at Presteigne; and the sheriff's county courts for the recovery of small debts, are

held every alternate month here, and at the town last mentioned. The representative for the borough is chosen by the burgesses of New Radnor, in conjunction with those of the boroughs of Knighton, Rhaiadar, Cefn Lllys, and Cnwclas; the bailiff being the returning officer. As nothing but the circumstance of receiving parochial relief disqualifies any person from becoming a burgess, the number of voters is considerable; and those of New Radnor are supposed to exceed 300, and the whole number, including those of the contributory boroughs, is estimated to be about 1300. To be a capital burgess of New Radnor, however, actual residence within the jurisdiction is essential, which is not the case as to the contributory boroughs: and if a capital burgess becomes non-resident he loses his privileges as such. A benefit society, established here in 1778, at present consists of above 100 members, who hold their annual meetings on the 6th of January.

Weekly markets were formerly held here on Tuesdays, but these are, at present, only nominal, notwithstanding some late attempts to restore them. There are still, however, five annual fairs, and there is also an annual wake on the third Sunday in the month of August. The parish of Radnor is divided into three portions, of which the town of New Radnor is the principal, containing, according to the parliamentary returns of 1811, 75 houses, and 380 inhabitants. The public buildings here are the town-hall, the prison, and the church. The last consists of a nave, south aisle, and chancel, with a tower at the west end.

Radnor castle stood on an eminence commanding the town. Of this once majestic pile, a few fragments of walls only remain, but the entrenchments are still entire; the outer ward, called Baili-Glas, or the Green Court-Yard, is yet distinct from the inner one, or keep, and is nearly in its original form. In 1773, on digging within the area of this castle, six or seven small "Gothic arches of good masonry were discovered," besides a variety of ancient instruments. The forest of Radnor extends several miles to the north of the town, covering the slope of a lofty eminence, from the summit of which are very extensive prospects. The principal seats in the vicinity are Downton-hall, the seat of Percival Lewis, esq. and Harpton-court, a seat belonging to Thomas Frankland Lewis, esq. Both these mansions are surrounded by beautiful scenery, and are highly ornamental to this district. About two miles westward from the town is a celebrated water-fall, called Water-break-its-neck, seventy feet in perpendicular height; but it is extremely defective in water, except during the time of floods, when the effect produced is truly grand. At the western extremity of the parish is an intrenched dyke, which formerly extended across the whole vale of Radnor. War-clofe, a field to the eastward of the town, is traditionally said to have been the scene of some military contest, but no particulars respecting it are preserved.

Old Radnor, or *Pen-y-Craig*, is a small village, situated about three miles to the south of New Radnor. Camden supposes it to have been the *Magnos Antoninus*, which was garrisoned by the Phœnician regiment in the reign of Theodosius the younger; and there seems every reason to believe that it was a place of note in the Romo-British period. The Roman road passed close to the base of the hill upon which the village stands. The church here is a venerable old edifice of stone, with a massive square tower at one end. A curious screen, richly carved in wood, extends across the nave and side aisles. Here are various monuments to the memory of members of the Lewis family of Harpton. Carlisle's *Topographical Dictionary of Wales*, 4to. 1813. Lipscomb's *Tour through Wales*.

RADNOR, a small pleasant town of America, in Delaware county, Pennsylvania. The place was originally called "Amflet" by the Dutch, who began to build here. The number of inhabitants is 925.

RADNOR, a town of South Carolina; 10 miles S.W. of Edmondsbury.

RADNORSHIRE, an inland county of South Wales, is bounded on the north by the counties of Montgomery and Salop, on the east by the county of Hereford, and on the fourth and west by the counties of Brecknock and Cardigan. According to Mr. Clark, it contains 510 square miles, or 346,000 acres, and is politically divided into six hundreds, and fifty parishes; some of which are within the diocese of Hereford, and the remainder within that of St. David's. The parliamentary returns of 1811, state the number of its houses at 4194, and of its inhabitants at 20,900. It sends two members to parliament; one for the county, and one for the borough of New Radnor, with its contributory boroughs. The face of the country is extremely mountainous and bleak in every part of it, but it is intersected by several vallies, which are watered by the Wye, the Teime, the Lugg, the Ithan, the Eddow, and their respective subsidiary streams. These vallies afford a considerable extent both of meadow and arable land; especially the Vale of Wye-Side, and the Vale of Radnor, some portions of which are very fertile, and have a good soil and a congenial climate. In the other parts of the county, however, a barren soil, and a chilly atmosphere, are the predominant characteristics. Nearly two-thirds of its whole extent being either in a state of commonage, or lying wholly waste, agriculture has hitherto made little comparative progress here. Cattle and sheep consequently constitute the chief produce of the county. The number of the latter is indeed very great. Hence Radnorshire is famed for its supply of wool; but notwithstanding this circumstance, singular to say, the manufacture of woollen goods is totally disregarded. The raw material is sold to the manufacturers of the north, by whom the inhabitants of this county are in return furnished with cloth.

Radnorshire contains three market-towns; Presteigne, Rhaiadar, and New-Radnor. The market at the last, however, is only nominal. The county courts are held at Presteigne, which is now the most important and flourishing town in the county. (See PRESTEIGNE.) The chief remain of antiquity within its limits is Offa's Dyke, which commencing at the river Wye, near Hay, skirts the counties of Radnor and Hereford, and passes into Montgomeryshire at Pwll-y-Pyod, a hamlet on the road between Bishop's-castle and Newtown. The only religious house in the county was the abbey of Cwm Hir, founded in 1143, for monks of the Cistercian order, by Cadwathelan-ap-Madoc, which, at the dissolution, was valued at 28*l.* 17*s.* 4*d.* *per annum*. Of this monastery a considerable part of the buildings is yet standing, though in a very ruinous and dilapidated condition. Leland, in his Itinerary, (vol. v. p. 13.) speaks of its church as the longest in Wales, and informs us, that it was "spoiled and defaced by Owen Glendower." The principal castles in Radnorshire were those of Colewine, Tynbont, Aberhedow or Aber-Edwy, Ewenlles, Radnor, Rhaiadar, and Pain's-castle. Several antiquaries, among whom are Camden, Gale, and Ward, place the Roman station Magnos, or Magna, at Old Radnor, as is mentioned above; but Baxter contends that it should be fixed at Ledbury, in Herefordshire, and Harris at Gaer, near Brecknock. In this county, particularly on the summit of Gwafledin hill, are several of those collections of stones called in South Wales *karneu*, in North Wales, *kar-nedheu*, in Scotland, *cairns*, and in Ireland, *duns*.

Radnor was erected into an earldom by Charles II., in the person of John Roberts, lord Roberts of Truro, but that title became extinct in 1757. It was revived, however, in 1765, in the person of William Bouverie, baron Longford, and viscount Folkestone, whose son Jacob, now earl of Radnor, enjoys his privileges. General View of the Agriculture of the County of Radnor, by John Clark, 4to. Skrine's Tours in Wales. Camden's Britannia. Pennant's Tour in Wales. 8vo.

RADNORTH, a town of Transylvania, on the river Maros; 23 miles W. of Scherburg.

RADÖE, a small island in the North sea, near the coast of Norway. N. lat. 60° 35'.

RADOFFIN, a town of Moravia, in the circle of Iglaui; 21 miles E. of Iglaui.

RADOLFZELL, or **RATOLFZEIL**, or *Zell*, a town of Germany, in Austrian Swabia; situated on the Untersee, or lake of Lile; 10 miles N.W. of Constance.

RADOM, a town of Poland, in the palatinate of Sandomirz; 50 miles N.N.W. of Sandomirz.

RADOMISCHL, a town of Bohemia, in the circle of Prachatitz; four miles N. of Strakonitz.

RADOMISL, a town of Poland, in the palatinate of Lublin; 45 miles S. of Lublin.—Also, a town of Poland, in the palatinate of Kiev; 56 miles N.W. of Kiev.

RADOMSK, or **RADOMISKI**, a town of Poland, in the palatinate of Siradia; 32 miles S.E. of Siradia.

RADONITZ, a town of Bohemia, in the circle of Saatz; 13 miles W.S.W. of Saatz.

RADOSCHITSCH, a town of Poland, in the palatinate of Sandomirz; 20 miles N.E. of Malogocz.

RADOSKU, a town of Prussia, in the palatinate of Culm; 10 miles W. of Lautenburg.

RADSTADT, a town of the archbishopric of Salzburg; 36 miles S.S.E. of Salzburg.

RADT *vor dem Walde*, a town of the duchy of Berg, where Roman Catholics, Lutherans, and Calvinists, have, each of them, a church; 25 miles E. of Dasselldorp.

RADULA. See RASPARTORY.

RADUNPOUR, or **RADIMPOUR**, in *Geography*, a town of Hindoostan, in the country of Agimere, on the river Puddar, or Butlafs; 171 miles N. of Surat. N. lat. 23° 58'. E. long. 71° 48'.

RADZANOW, a town of the duchy of Warsaw; 30 miles N.E. of Plozko.

RADZIECZOW, a town of Poland, in the palatinate of Belcz; 24 miles W. of Belcz.

RADZIEJOW, or **RODSCHOWA**, a town of Poland, in the palatinate of Brzestye; 25 miles W. of Brzestye.

RADZIVILOW, a town of Lithuania; 50 miles E.N.E. of Minsk.

RADZYMIN, a town of the duchy of Warsaw; 12 miles N. of Warsaw.

RAEMSDONCK, or **RAMSDONCK**, a small but strong place of Brabant; three miles E. of Gertrudenberg.

RAEPOUR, a town of Hindoostan, in the circar of Gohud, on the Jumnah; 38 miles E.N.E. of Lahaar.

RAERDORP, a town of Holland; five miles N.E. of Amsterdam.

RÆTVIK, a calcareous mountain of Sweden, the height of which is estimated by Bergman at 6000 feet above the sea, observing also, as a singularity, that upon this mountain, and that of Rodaberg, are found vast blocks of reddish felspar, mingled with quartz and brown mica.

RAFAEL, **CAPE**, a cape on the E. coast of the island of Hispaniola. N. lat. 19° 2'. E. long. 69° 46'.

RAFAEL, *St.*, a town of South America, in the province of

of Caraccas; 40 miles S. of Caraccas.—Also, a town of South America, in the province of Moxes; 210 miles E. of Santa Cruz de la Sierra la Nueva.—Also, a town of New Navarre; 105 miles S.W. of Casa Grande.

RAFAH, a town of Egypt; 57 miles N.E. of Catieh.

RAFALSO, a small island in the gulf of Finland. N. lat. 60° 20'. E. long. 26° 12'.

RAFFAELLE DA URBINO, in *Biography*. See RAPHAEL.

RAFFLING, a sort of game with three dice, in which he who throws the greatest pair, or pair royal, in three casts, wins the prize or stake.

The word probably comes from the base Latin, *rieflare*, to rifle, plunder, take all away.

The raffle is properly the doublet or triplet: a raffle of aces, or ducats, carries it against mere points.

RAFFLING is also used when a company of persons club to the purchase of a commodity, or make small deposits, amounting in the whole to its full value; and he that throws the highest on three dice, or who has the highest number by means of balls thrown on a bagatelle or porto-bello table, takes it.

RAFICA, in *Geography*, a town of Asiatic Turkey, in the government of Diarbekir; three miles S. of Raca.

RAFLUNDA, a town of Sweden, in the province of Skone; 17 miles S. of Christianstad.

RAFANIA, in *Botany*, a genus of plants, separated from the Linnæan *Crotalaria* and *Liparia*, augmented with several new species from the Cape, and named by its author, professor Thunberg, in the second part of the preface to his *Prodromus Plantarum Capensium*. De Theis is completely in the dark as to the person commemorated in this name, who can be no other than Mr. C. G. Rafn of Copenhagen, author of a *Flora of Denmark and Holstein*, in the Danish language, published in the years 1796 and 1800, in octavo, making two volumes, which include the first ten classes of the Linnæan system. We know not whether any more has appeared. The same botanist has written a work on the physiology of plants; and several papers for the Academy of Sciences at Copenhagen. See Sims and König's *Ann. of Bot.* v. 1. 6.—Thunb. *Prodr.* 123. præf. n. 48. Willd. *Sp. Pl.* v. 3. 949. Ait. *Hort. Kew.* v. 4. 261.—Class and order, *Diadelphia Decandria*. Nat. Ord. *Papilionaceæ*, Linn. *Leguminosæ*, Juss.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, bell-shaped, five-cleft, ringent; the upper lip in two broadish distant segments; lower divaricated, in three acute ones, the middle one smallest. *Cor.* Papilionaceous. Standard large, heart-shaped, acute, spreading, depressed at the sides. Wings ovate, about half as long as the standard. Keel acute, the length of the wings. *Stam.* Filaments ten, all united into a linear tube, split along the base; five of them rather the shortest; anthers simple. *Pist.* Germen stalked, linear; style simple, bent upwards at nearly a right angle; stigma obtuse. *Peric.* Legume stalked, oblong-lanceolate, compressed, of one cell and two valves. *Seeds* several, stalked, roundish-kidney-shaped.

Eff. Ch. Stamens all united. Calyx ringent; upper lip divided; lower divaricated, in three segments, the middle one smallest. Legume stalked, lanceolate, compressed.

Obs. The first species in Willdenow, *perfoliata*, *Crotalaria perfoliata* of Linnæus, figured in Smith's *Insects of Georgia*, v. 2. t. 67, is *Baptisia perfoliata* of Brown, in Ait. *Hort. Kew.* v. 3. 5, a genus adopted from Ventenat, and belonging to the *Decandria Monogynia*.

1. *R. amplexicaulis*. Orbicular Rafnia. Thunb. *Prodr.* 123. Willd. n. 2. (*Crotalaria amplexicaulis*; Linn. *Sp.*

Pl. 1003. *Genista perfoliata*, orbiculatis foliis; Seb. *The-saur.* v. 1. t. 24. f. 5. *Linn.*)—Leaves reticulated, orbicular, clasping the stem, alternate; the floral ones opposite, coloured.—Native of the Cape of Good Hope. A smooth, handsome, branched shrub, clothed with entire leaves, from one to two inches across, finely reticulated with innumerable veins; the upper ones, which accompany the flowers, smaller, and pale yellowish. Flowers solitary, nearly sessile, yellow, smaller than the floral leaves.

2. *R. elliptica*. Elliptical Rafnia. Thunb. *ibid.* Willd. n. 3, excluding the reference to Andrews.—Leaves slightly veined, elliptic-ovate, acute, alternate; the floral ones opposite, not longer than the flowers.—Native of the Cape. Confounded by Linnæus with the foregoing, from which it differs in having much smaller leaves, sessile, not clasping the stem, quite destitute of reticulated veins. Flowers of a deeper yellow, as long as the floral leaves.

3. *R. cuneifolia*. Wedge-leaved Rafnia. Thunb. *ib.* Willd. n. 4. (*Spartium ovatum*; Berg. *Cap.* 197.)—Leaves obovate, somewhat wedge-shaped. Branches angular. Flowers racemose, terminal.—From the same country. Stem arborescent. Branches rather angular, striated, smooth. Leaves numerous, alternate, ovate, pointed, succulent, smooth, above an inch long; contracted at the base, and tapering down into broad footstalks. Flowers purplish-yellow, in terminal, corymbose clusters. Bergius.

4. *R. triflora*. Three-flowered Rafnia. Thunb. *ib.* Willd. n. 5. Ait. n. 1. Venten. *Malmaif.* t. 48. (*Crotalaria triflora*; Linn. *Sp. Pl.* 1004. Curt. *Mag.* t. 482. *Borbonia cordata*; Andr. *Repos.* t. 31, excluding the synonym.)—Leaves ovate, smooth. Branches angular. Stalks single-flowered, three together. Native of the Cape, where it was gathered by Sparrmann and Thunberg, and from whence its seeds were sent to Kew garden, in 1786, by Mr. Francis Masson. The plant is biennial, requiring to be sheltered in winter, and flowering in June and July. Stem branched, about a yard high, most leafy in the upper part, smooth, and of a glaucous green, as well as the leaves, which are numerous, alternate, almost sessile, more or less ovate, but varying in size and breadth. Flowers abundant at the summits of the branches, large, yellow, axillary, stalked, three together, the floral leaves smaller than the rest, and often tinged with purple.

5. *R. opposita*. Opposite-leaved Rafnia. Thunb. *ib.* Willd. n. 6. (*Crotalaria opposita*; Linn. *Suppl.* 322. *Liparia opposita*; Linn. *Syl.* *Veg.* ed. 13. 554. *Spartium capense*; *Sp. Pl.* 995. *Cytisus capensis*; Berg. *Cap.* 117.)—Leaves elliptic-lanceolate; the upper ones mostly opposite. Flowers lateral, on short solitary stalks.—Native of the Cape, apparently unknown in our gardens. Linnæus and his son confounded many different things under this species, some of which being marked in their herbarium as having been gathered by Thunberg, we presume to be among those he has defined; yet it is not possible to determine them all by his short characters, several of which unfortunately contradict the specific names. The stem of the present is described by the younger Linnæus as simple, he considering as flower-stalks the copious, alternate, leafy branches, three or four inches long, on which one or two pair of the lower leaves are opposite; the proper floral leaves, like those of the stem, being alternate: all the leaves are elliptic-lanceolate, or somewhat obovate, acute, entire, single-ribbed, an inch or more in length. Flowers either lateral or axillary, among the uppermost leaves, solitary, each on a simple stalk about the length of its calyx. Corolla yellow, not half so large as the last species.

6. *R. axillaris*. Axillary Rafnia. Thunb. *ib.* Willd.

n. 7.—“Leaves lanceolate, alternate or opposite. Flowers terminal.”—This and all the following were gathered by professor Thunberg, at the Cape. In the Linnæan herbarium is a specimen, by whom gathered does not appear, which seems to answer to the above character, (except the leaves being linear-lanceolate,) and which may perhaps explain the paradoxical contrariety between the specific name and character. In this specimen the flowers are really terminal, being solitary at the ends of copious, short, leafy, lateral branches, which are axillary. The whole foliage has a Hyssop-like aspect.

7. *R. angulata*. Angular Rafnia. Thunb. ib. Willd.

n. 8.—“Leaves lanceolate, alternate. Flower-stalks lateral. Stem angular.”

8. *R. spicata*. Spiked Rafnia. Thunb. ib. Willd.

n. 9.—“Leaves lanceolate, alternate. Flowers axillary, racemose.”—Of this species alone, it seems, Willdenow had seen a dried specimen, and we regret that he did not give us some account of it.

9. *R. angustifolia*. Narrow-leaved Rafnia. Thunb. ib. Willd. n. 10.—“Leaves lanceolate, alternate. Flower-stalks lateral. Stem round.”

10. *R. filifolia*. Thread-leaved Rafnia. Thunb. ib. Willd. n. 11.—“Leaves linear-lanceolate, alternate. Flowers axillary.”—The Linnæan herbarium contains two specimens, specifically different, which we presume belong to this and the last, but no human sagacity can appropriate them; except that one of them, with large and seemingly purplish flowers, having rather the narrowest leaves, may be taken for *filifolia*. This is marked as gathered by Thunberg. The other has much smaller and yellow flowers. The stem is round in both.

11. *R. retroflexa*. Bent Rafnia. Thunb. ib. Willd. n. 12.—“Leaves obovate. Branches reflexed backwards and forwards.”—A specimen from Thunberg answers to the above name and character, except the leaves being rather linear-lanceolate than obovate. Their colour is somewhat glaucous. Flowers mostly terminal, solitary, on short stalks, with an awl-shaped bractea, or abortive leaf, at the base of each stalk.

12. *R. erecta*. Upright Rafnia. Thunb. ib. Willd.

n. 13.—“Leaves oblong. Flowers lateral. Stem erect.”

13. *R. diffusa*. Prostrate Rafnia. Thunb. ib. Willd.

n. 14.—“Leaves ovate, smooth. Stem decumbent.”

All the species turn more or less black in drying. For *Rafnia retusa* of Ventenat, Malmaison. t. 53, see TEMPLETONIA hereafter, and Ait. Hort. Kew. v. 4. 269.

RAFSO, in Geography, a small island on the E. side of the gulf of Bothnia. N. lat. $61^{\circ} 37'$. E. long. $21^{\circ} 12'$.

RAFSUND, a town of Sweden, in the province of Jamtland; 28 miles S.E. of Frofon.

RAFT, in Sea Language, a sort of float formed by an assemblage of various planks, or pieces of timber, fastened together side by side, so as to be conveyed more commodiously to any short distance in a harbour or road, than if they were separate. The timber and planks, with which merchant-ships are laden in the different parts of the Baltic sea, are attached together in this manner, in order to float them off to the shipping.

This means of conveying timber to navigable situations may be advantageously practised in many places. It is found of great utility in many of the northern parts of the island as well as others, near canals and waters, where a cheap conveyance for such articles is required.

The balsa or catamaran used by the Indians and Spaniards in South America, is only a raft made of the trunks of the balsa; for an account of which, see the article BOAT.

They have one mast, on which is hoisted a large square sail; and a pair of sheers, whose heels rest on each side the mast. When a fore-slay sail is set, a pair of sheers is rigged forward. These rafts were the first conveyance by water, no doubt, long before vessels of a better construction were thought of; and what is rather surprising, they are made to sail with foul winds, and steer, as well as any other kind of vessel, by means of an invention similar to, and perhaps the original of, that which is now called “a sliding-keel.” They have for this purpose planks about ten feet long, and fifteen to eighteen inches wide, which slide vertically in the spaces between the trunks which form the raft. It is only necessary to immerge them more or less, and put down a greater or less number at the fore or after part of the raft, to make it either luff-to, or fall-off from the wind, tack, veer, lie-to, and perform every necessary manœuvre. The number of these planks is five or six, and if one of these planks be drawn up forward, the raft will keep away; and, if one is raised abaft, it will come to the wind. This sort of raft, from the simpleness of its construction, might perhaps be well adapted to many cases of emergency, after shipwreck upon coasts, destitute of all other materials for ship-building.

RAFT-Port, in a Ship, a square hole cut through the futtocks of some ships, immediately under the counter, to receive the planks or pieces of timber which are brought to lade her for transportation; and which, on account of their great length, could not be received aboard otherwise.

RAFTERING, in Agriculture, a provincial term used for a sort of ploughing in narrow ridges, or small ridglets. It is useful for exposing a large surface of earth to the influence of the atmosphere.

RAFTERS, in Building, are pieces of timber, which, standing by pairs on the rafter-piece or raising-piece, meet in an angle at the top, and form the roof of a building.

It is a rule in architecture, that no rafters should stand farther than twelve inches from one another.

For the sizes or scantlings of rafters, it is provided by act of parliament, that principal rafters from 12 feet 6 inches to 14 feet 6 inches long, be 5 inches broad a-top, and 8 at the bottom, and 6 inches thick. Those from 14, 6, to 18, 6 long, to be 9 inches broad at the foot, 7 a-top, and 7 thick. And those from 18, 6, to 21, 6, to be 10 inches broad at the foot, 8 a-top, and 8 thick.

Single rafters, 6 feet 6 inches long, to be 4 and 3 inches in their square.

RAFTY, a provincial term signifying damp and musty, as corn or hay in a wet season.

RAG, or RAKE, among Hunters, denotes a company or herd of young colts.

RAG, or Ragg, Rowley, in Mineralogy. See FERRILITE.

RAG, a torn piece of cloth of any sort. See the next article.

RAGS, Woollen, as well as the clippings of pitch marks upon sheep, are good manure. The rags should be chopped small, about an inch or two square, and scattered on the earth at the second ploughing; for being thereby covered they will begin to rot by seed-time. They imbibe the moisture of dews and rain, retain it long, and, according to Dr. Home, keep loose dry soils in a moist state. They formerly cost about fourpence a bushel at London, from whence many loads were sent every year to Dunstable, which is thirty-three miles, where they are laid on even stiff lands, just after the sowing of the corn, allowing to the acre four sacks, of six bushels each; they are much higher now, at more than

double

double this price, and no quantity of any great account to be procured. See *MANURE*, and *Top-dressing*.

The farmers in Oxfordshire make use of rags of this sort, procuring them from London and other places, at the rate of from eight to nine pounds the ton, which, with the carriage, land them in upon the farms from nine pounds ten shillings to ten pounds. By some they are spread upon the clover lands, lays or layers for wheat, in the proportions of from three or four to six hundred weight to the acre. Tried with dung in this way, in the quantity of seven hundred weight to the acre, the dung is found the better dressing. They are also applied for turnips, for which crop they are ploughed in before the winter, as soon as the wheat-sowing is over: if ploughed in at the time of sowing turnips, they will not work for that crop. Some for this crop give half a coat of rags, and half a coat of sheep-fold. When applied on the clovers they seldom last longer than two years. Others think that half a coat of rags, and half a coat of dung, is the most beneficial method of applying this sort of manure. Some think rags are more durable than any other manure. Rags are occasionally brought from Whitney to this district, at from seven shillings and sixpence to eight shillings and sixpence the hundred weight, and five hundred weight spread upon the acre: they commonly last only one crop, but sometimes for two, and are found superior to any thing for wheat. They are ploughed in; and if the season be very dry, do not answer so well. They are supposed to do best on a summer fallow for that crop.

In Suffex rags are chiefly of service in the hop grounds, for which they are thought an excellent manure. Very great benefit is said to have been derived from the application of these rags, in contributing to preserve this sort of plantation in a state of constant moisture and vegetation in the driest seasons, when grounds which have been manured with dung, have been dried up, and the hop crops have failed. Rags have likewise been found very useful on the mowing grounds in some parts of Lancashire, when laid upon them in a pretty full proportion. When cut or chopped sufficiently small, they readily sink down upon the surface of the land, and do not afford any sort of interruption to the scythe, while they absorb and keep in the moisture, which is of material benefit to such grass lands as are inclined to be dry.

RAG, in a *Ship*. See *BOLTS*.

RAGAL, in *Geography*, a town of Germany, in the county of Pludentz; 10 miles E. of Pludentz.

RAGALBUTO, a town of Sicily, in the valley of Demona; 23 miles S. of Cefalu.

RAGALMATO, a town of Sicily, in the valley of Mazara; 8 miles N. of Naro.

RAGAMMEE, a town of Ceylon, near the W. coast; 58 miles S. of Colombo.

RAGANELLO, a river of Naples, which runs into the gulf of Tarento, near Civita Mandonia.

RAGAPILLY, a town of Hindoostan, in Golconda, near the left bank of the Godavery; 5 miles S.E. of Badrachillum.

RAGATZ, a town of Switzerland, in the county of Sargans; 5 miles S.S.E. of Sargans.

RAGAY, a town on the S. coast of the island of Luzon. N. lat. $13^{\circ} 50'$. E. long. $122^{\circ} 40'$.

RAGGED, in *Heraldry*. See *RAGULED*.

RAGGED Hawk, in *Falconry*, is a hawk that hath its feathers broken.

RAGGED Robin, in *Botany*. See *LYCHNIS*.

RAGGED Harbour, in *Geography*, a bay on the E. coast of Newfoundland, being a part of Catalina bay; 2 leagues

N. of Catalina harbour. N. lat. $49^{\circ} 45'$. W. long. $53^{\circ} 40'$.

RAGGED Helmet, a small island in the Mergui Archipelago. N. lat. $10^{\circ} 9'$.

RAGGED Island, a small island in the East Indian sea, near the island of Paraguay. N. lat. $11^{\circ} 24'$. E. long. $119^{\circ} 30'$. —Also, a small island among the Bahamas. N. lat. $22^{\circ} 27'$. W. long. $77^{\circ} 16'$.

RAGGED Point, a cape on the E. coast of the island of Borneo. S. lat. $2^{\circ} 13'$. E. long. $116^{\circ} 40'$. —Also, a cape on the N. coast of the island of St. Christopher. N. lat. $17^{\circ} 30'$. W. long. $62^{\circ} 42'$.

RAGGIVOLO, a town of Italy, in the department of the Mincio; 19 miles S. of Mantua.

RAGHU, in *Hindoo Mythology*, is the name of the ancestor of Rama, one of their deified heroes, who is hence sometimes called Raghuva, or son of Raghu. Budha, or Boodha, another of the Indian deities, is said to have had a son also of this name.

RAGHUVA, a name of the Hindoo deified hero Rama, signifying a descendant of Raghu, a warlike character. All these names are still very common among Hindoos: whether confined to the sect who, as chiefly worshipping Rama, are called Ramanuj, or more extensively given, we are not informed. See *RAMA*.

RAGIAN, in *Geography*, a town of Persia, in the province of Farfistan; 130 miles N.W. of Schiras. N. lat. $30^{\circ} 40'$. E. long. $50^{\circ} 8'$.

RAGLAND, a small village of Monmouthshire, here mentioned on account of its castle, the ruins of which evincing its grandeur and magnificence, command the attention of travellers. During the rebellion it was held for the king, and defended to the last extremity by the marquis of Worcester; 8 miles W. of Monmouth.

RAGMAN'S ROLL, or *Ragimund's Roll*. See *ROLL*.

RAGNIT, in *Geography*, a town of Prussian Lithuania, on the river Memel, endowed with the privileges of a town in the year 1722. Its ancient castle was famous even in the times of Paganism. The knights of the Teutonic order rebuilt it, with additional works, in 1255; but being destroyed in 1355, it was rebuilt a second time, and called Landshuth; but afterwards it obtained the name of Ragnit from the river which passes by it; 56 miles E.N.E. of Königsberg. N. lat. $55^{\circ} 5'$. E. long. $22^{\circ} 18'$.

RAGOONA, a town of Italy, in Friuli; 16 miles N.W. of Udina.

RAGOOGUR, a town of Hindoostan, in the Malwa country, and circar of Kitchwana; 116 miles N.E. of Ougein. N. lat. $24^{\circ} 23'$. E. long. $77^{\circ} 30'$.

RAGOTSKI, FRANCIS, in *Biography*, the second of the name, prince of Transylvania, distinguished by his courage and patriotism, was born in 1676, at the castle of Borshi, in Hungary. When he was only a year old he lost his father, prince Francis, and was left to the care of his mother, Helena Sereni, who afterwards married count Tekeli. During his education he was carefully watched by the house of Austria, and his correspondence with his mother, who had retired to Constantinople, was entirely broken off. He was now suffered to travel to most of the courts of Europe, and to contract a marriage with the princess of Hesse Rhinfelds. Zealously attached to the independence of his country, which was kept in a state of great degradation by the Imperialists, he secretly entered into a negotiation with the French king, Lewis XIV., but being betrayed by one of his confidants, he was arrested, and a charge of treason was preferred against him. The sentence of guilty was soon pronounced, and he was committed to the custody of an officer,

officer, who, however, connived at his escape, and he arrived in a dragoon's habit at the frontiers of Poland. Here he received assurances of assistance from France, and immediately published an eloquent manifesto, calling upon the nation to free itself from the Austrian yoke. Numbers joined him; being, however, but half armed, he was fearful of trusting his cause in their hands, and withdrew to the frontiers of Poland, where he was joined by fresh recruits. With these he ventured to make some progress; stormed several fortresses; and took a severe revenge upon the Imperialists, who had given no quarter to the Hungarian insurgents.

At this period the crown of Poland was vacant, through the deposition of Augustus by Charles XII. of Sweden, and the Polish chiefs were desirous of placing it upon the head of Ragotki. But he had no such ambitious views: his great object was to liberate his country, and he refused to desert its cause for any other prospects. He accordingly pursued his successes, and by the reduction of Tokay, obtained the submission of almost the whole of Lower Hungary. So high was his reputation, that the diet of Alba Julia, in 1704, proclaimed him prince of Transylvania, with which dignity he was afterwards solemnly invested. He obtained likewise the title of protector of Hungary, and Lewis XIV. sent to him a public embassy. He soon began to feel the difficulty of supporting a popular insurrection against the arms and policy of a powerful sovereign, as well by the abandonment of some of his allies, as by the desertion of his troops. He had another opportunity of giving a refusal to the crown of Poland, which was offered him by the czar Peter, shewing thereby his sincere attachment to the cause of his country, and he employed all the resources of valour and good conduct to support a declining cause. In 1711, a treaty was concluded between the Hungarian states and the emperor, into which he refused to enter, although the first article secured his life and property, with the title of prince of Transylvania. Mortified by the failure of his patriotic exertions, he withdrew to Turkey, renouncing his great estates, and preferring an honourable poverty to a splendid servitude. He afterwards passed some time in France, then returning to Turkey, he fixed his final residence at the castle of Rodosto, on the sea of Marmora. "There," says his biographer, "a Christian among Mahometans, and a philosopher among barbarians, he tranquilly closed his life in 1733, at the age of 61." He left "Memoirs of his Life," which were published in the "Revolutions de Hongrie," printed at the Hague in 1739. In 1751 there appeared a work, entitled "Testament politique et moral du Prince Ragotki," the authenticity of which is doubted. Moreri.

RAGOUT, or RAGOO, a sauce or seasoning, intended to increase or recover the appetite when languishing, or lost.

The term is French, but naturalized. It is also used for any high-seasoned dish, prepared of flesh, fish, greens, or the like, by stewing them with the addition of bacon, salt, pepper, cloves, and the like high-flavoured ingredients.

We have ragoos of beef, of cray-fish, of giblets, of asparagus, of endive, of cocks-combs, of gammon, of celery, &c.

The ancients had a ragout, called *garum*.

RAG-PAVING. See PAVING.

RAG-STONE, a name given by our artificers to a kind of stone, which they use for setting an edge upon knives, chisels, and other tools. It is a greyish-coloured stone, containing a large quantity of talcky particles, and splits easily into thin flakes. It is a soft stone, and is used only to finish the setting an instrument after the edge has been prepared by

grinding or rubbing the tool upon some other stone of a coarser texture. We have this from Newcastle and many other parts of the north of England, where there are very large rocks of it in the hills. This kind of stone is in some districts considerably blended and intermixed with the subsoil, rendering it of a more barren and unfertile quality.

RAGUENET, L'ABBE, in *Biography*. In 1702 the publication of a pamphlet, entitled "*Paralele des Italiens et des François en ce qui regarde la Musique et les Operas*," by this author, a man of taste and intelligence, who had resided some time at Rome, gave birth to a long, but ineffectual controversy, concerning the degrees of perfection, and superiority of French and Italian music. The book was licensed by Fontenelle, who said in his testimony, that "he thought it would be very agreeable to the public, provided they were capable of equity." This declaration, however, did not prevent Freneuse, the continuator of Bonnet's "*Histoire de la Musique*," from attacking the author and Italian music in a most furious manner, treating both with equal contempt and obloquy.

The French, after this period, seem to have enjoyed their lyric *femmes* in great comfort and tranquillity till 1752; when the performance of Pergolesi's "*Serva Padrona*" at Paris, by a company of burlesque singers from Italy, set the musical republic in a flame which has not yet been extinguished.

There had, indeed, been a *sensation* excited, that was rather turbulent, and tending to a civil war, on the first appearance of Rameau as a dramatic composer in 1733; who, by new harmonies and accompaniments, had given offence to the true believers in the worship of Lull; but this soon subsided, and the nation not only heard his compositions with rapture, but revered him as "a theorist, to whom music was as much indebted as physics and philosophy to Newton."

This little work was published in English in 1709, and has been said to be translated by Galliard. If this worthy professor was the translator, it was before he had made himself so completely master of the English language, as he appeared to be afterwards, in his translation of "*Tom's Second Song*." The English of this *paralele* is feeble and inaccurate; many of the notes, however, are good, and might be a person who had been in Italy, and well knew the state of music in that country, as well as in England, at the beginning of the last century, during our first attempts at operas, before the arrival of Handel.

RAGUIER, LE, the name given by the French sailors to a wind peculiar to the gulf of Alexandretta or Scanderoon, which, rushing from the snowy summits of the mountains, frequently forces ships to drag their anchors several leagues.

RAGULED, or RAGGED, in *Heraldry*, is applied to an ordinary, *c. gr.* a cross, whose outlines are jagged or knotted.

He beareth fable, a cross raguled, or, by the name of *Sloway*.

Ragged differs from indented, as the latter is regular, and the former not.

The bearing is very ancient: Julius Cæsar gave for his badge, a boar's head, on a ragged staff.

RAGULED is sometimes also used in the sense of truncated, or couped, and applied to a branch that is sawed from the tree; or a stock sawed from its root.

RAGUN, in *Geography*, a town of Germany, in the principality of Anhalt-Deßau, on the Mulda; 9 miles S. of Deßau.

RAGUNDA, a river of Sweden, which rises in the lake

lake Storfio, and in the province of Medelpadia, changes its name to Indal.

RAGUSA, a small republic, situated on the eastern shore of the Adriatic, and nevertheless regarded as an Italian state. It has a population of about 56,000 persons, on an extent of 352 square miles. As this state is adjacent to the territory formerly belonging to the Venetians in Dalmatia, its government was formed on the model of the Venetian aristocracy. Its religion is the Catholic, and its language the Slavonic, though most of the inhabitants speak Italian. The see is archiepiscopal, with six suffragans, and its commerce is considerable. The chief magistrate of the aristocracy in this island, called the "rector," is changed every month. Here is also a council of ten, and a great council composed of all the nobles above twenty years of age, and these nominate the "Pregadi," a senate of sixty, which superintends all state affairs, receives and deposes ambassadors, and confers offices. The revenue of Ragusa was formerly estimated at a ton of gold, or about 10,000*l.* sterling. This small republic has found it necessary to engage the protection of the Turks, for which it pays a tribute of about 20,000 sequins; though the commerce is beneficial to the Ottomans, in supplying them with ammunition. Jealousy of their neighbours induces the Ragusans to shut the gates of their city, except for a few hours in the day. The capital is Ragusa; and it has been lately annexed, together with Dalmatia, to the kingdom of Italy. It now (1814) probably waits for a new allotment. The Ragusans have many country-houses at Gravosa, another sea-port town. Stagno is another little town, subject to Ragusa. Of the Ragusan isles, the chief is Milet, or Melada, fertile in oranges, lemons, and good wine. On the north there is a tolerable haven, with a town of the same name. Three or four little isles in that neighbourhood also acknowledge the sovereignty of Ragusa.

RAGUSA, the capital of the above-mentioned island, is an ancient city, being the Ragusium of the Romans, and in the tenth century it became the metropolis of Dalmatia. In the 13th century it was conquered by the Venetians, and afterwards for a time subject to the crown of Hungary. It is a well-built city, and its commerce is not inconsiderable. The harbour might be rendered capable of a firm defence; and the circumjacent isles are beautified by nature and art. Earthquakes, however, have been terrible; and that of 1667 destroyed 6000 persons; 248 miles N.W. of Saloniki. N. lat. 42° 58'. E. long. 18° 18'.

Ragusa keeps accounts in ducats of 40 grossetti, each grossetto being divided into 6 foldi; but at the public offices accounts are mostly kept in perperi of 12 grossetti. Formerly the ducat represented a real coin struck at Ragusa, and had a fixed value; but since it has become a money of account, it is always equivalent to the Turkish piastre, and therefore liable to a change of value. At Ragusa no gold coins are struck; its silver are the old tallari or dollars, commonly called Vislini or Ragusine, weighing 1 oz. 7 car. (Ragusa wt.), containing 17 parts of pure silver to 13 of alloy, and reckoned at 1½ ducat, or 60 grossetti; but on account of the depreciation of the ducat, the value of the tallari has been proportionably raised in weight. The new tallari, called libertine, weighing 1 oz. 10 car. and containing 9 parts of pure silver to 6 of alloy, was valued at 80 grossetti. But since the year 1796, ducats have been coined of 40 grossetti, weighing ½ an ounce; also perperi of 12 grossetti, weighing 20 carats, and half perperi in proportion: these three coins contain 9 parts of pure silver, and 11 of alloy. The grossetti, none of which have been lately coined, are still in circulation; they weigh the 60th

part of an ounce, and bear the same value with the paras of Constantinople. The ducat of 1796 is worth 13¼*d.* sterling, which is nearly the value of the Turkish piastre. The tallaro, or Ragusina of 1759, is worse than the English standard 4 oz. 2 dwt.; its weight is 18 dwt. 7½ gr., content in pure silver 256.4 gr., and its value in sterling 2*s.* 11¾*d.* That of 1794 is worse 3 oz. 19 dwt., its weight 18 dwt. 17¼ gr.; its content in pure silver 267.6 gr., and value in sterling 3*s.* 1¼*d.* The ducat of 1797 worse 5 oz. 11 dwt.; its weight 8 dwt. 17¾ gr., content in pure silver 97 gr., and value in sterling 1*s.* 1½*d.* The tallaro or Ragusina has upon it the head of the chief magistrate, or rector; legend RECTOR REIP. RHACUSIN: reverse, arms of the city, legend, DUCAT. ET SEM. REIP. RAC., i. e. ducat and half of the republic of Ragusa. Pieces of 1794, &c. bear the head of a woman, with RESPUBL. RHACUS., reverse, a shield, with the word LIBERTAS, inclosed by two branches, over which is a crown, legend, DUCE DEO FIDE ET JUST. The ducat bears the whole length of a bishop, legend, AUSPICHS TUIS A DEO: reverse, arms of the city, legend, DUCAT REIP. RHACUSINÆ.

The pound with which gold and silver are weighed at Ragusa consists of 12 ounces; the ounce is divided into 6 faggi; the faggio into 22 carats, and the carat into 4 grains. But the pound of commercial weight is equal to 5607 English grains, or 12 oz. 13 dr. avoirdupois; the former being 5062½ English grains. The ell of Ragusa measures 22 7⁄8 French lines, or 20½ English inches. Kelly's Un. Cambiist.

RAGWORT, in *Botany*. See OTHONNA, SENECIO, and SOLIDAGO.

RAGWORT, in *Agriculture*, a very pernicious plant of the weed kind, which is sometimes termed seagrim. It has a green stalk in its early state, but, as it advances in age, inclining to violet or purple, especially downwards. Its flowers are yellow, and thick-set, and composed each of a number of small pointed leaves. It runs to seed in the latter end of summer. The smell, both of the stalk and leaves, which are jagged, as well as the flower itself, are so offensive to animals, as that hardly any will feed upon it, except when almost starved.

It has been proposed to destroy it by picking out the roots, and feeding the land close with sheep. It mostly affects meadows and pasture lands when the soils are good.

RAHA, in *Geography*. See JERICHO.

RAHABAH, or **RABBA**, town of Arabia Deserta, near the Euphrates, on the road by which caravans travel from Syria to the Arabian Irak; 110 miles S.W. of Mosul. N. lat. 35° 5'. E. long. 40° 21'.

RAHABAH Melik Ben Tauk, a town of Asiatic Turkey, in the province of Diarbekir, on the Euphrates; 50 miles S. of Kerkisieh.

RAHABY, a town of the desert of Syria, containing about five or six thousand inhabitants, situated on a plain, surrounded with date-trees; 70 miles N. of Mesghid Ali.

RAHANPOUR, a town of Bengal; 42 miles N.W. of Nattore.

RAHAPA, a small island in the East Indian sea, near the E. coast of Borneo. N. lat. 4° 58'. E. long. 114° 4'.

RAHAS, in *Ichthyology*, a name given by some authors to the torpedo, or cramp-fish.

RAHEINA, in *Geography*, a bay on the W. coast of Mowhee, one of the Sandwich islands. N. lat. 20° 50'. E. long. 203° 19'.

RAHEMAT, a large lake in the Arabian Irak, 90 miles in circuit, near Mesghid Ali.

RAHENSTEIN, a town of Bohemia, in the circle of Saatz; 19 miles S.W. of Saatz.

RAHMANIE, a town, or rather village, of Egypt, built

built on the W. bank, at the entrance of the canal of Dammanhour, which is navigable only at the rise of the Nile; 9 miles S. of *Fané*; which see.

RAHMET'ABAD, a town of Persia, in the province of Irak; 20 miles N.E. of Confar.

RAHNIS, or RANIS, a town of Saxony, in the circle of Neustadt; 10 miles S.W. of Neustadt. N. lat. $50^{\circ} 33'$. E. long. $11^{\circ} 40'$.

RAHNY, a town of Bengal; 25 miles N.W. of Dinagepour.

RAHON, a town of France, in the department of the Jura; 6 miles S. of Dôle.

RAHOON, a town of Hindoostan, in the subah of Lahore; 108 miles S.E. of Lahore. N. lat. $31^{\circ} 7'$. E. long. $75^{\circ} 42'$.

RAHU, in *Astronomy*, is the Hindoo name of the planet of the ascending node, or dragon's head. Ketu is the name of the other node; and a fable, in the usual style of mythological allegory, is given under that article, of their origin and mishap. The malignant Rahu was decapitated, and Ketu was his head. In one painting of the Hindoo zodiac, the headless Rahu is represented of a black colour, in red clothing, mounted on an owl, and holding a lotus in his hand: in another, he holds a spear, and stands on a tortoise. In the fable given under Ketu it is related that Vishnu was the decapitator of Rahu: other accounts assign that office to Narayana. Among the Hindoos, as we have had occasion to remark in several articles, their sciences, as well as their history and religion, are enveloped in a mass of mythological allegory: a farther instance of which, connected with the subject of this article, is seen under ECLIPSE (*Note*). A reference being made from the article KETU to this, we take the opportunity of correcting two typographical errors in that article. In its early part, for *Karyapa*, read *Karyapa*; and in the fourth line of the second column, for or read *a*.)

RAHWAY, in *Geography*. See RAWA.

RAI, or RAE, an ancient town of Persia, in the province of Irak, before Isfahan the capital of Persia. This was once a grand and proud city; and its ruins still cover a great extent of country. It holds a distinguished place in the annals of Persia: it is mentioned by Arrian and Diodorus Siculus, as the capital of the province of Rhages, so called from the calamities brought upon this part of the empire by the earthquakes to which it formerly was, and is still subject. It is frequently mentioned in the wars of the renowned Haroun al Rashid; it was the capital of this part of Persia, in the reign of Alp-Arslan, and continued to flourish until it was sacked by the generals of Jenghis Khan. Its ruins are situated five miles S. of Tehraun, the present capital of Persia; and in the centre of them is a village, called Sheik Abdul Azzeem, from a son of the seventh Inam, to whose memory a noble mosque and mausoleum have been erected.

RAJA, denoting *king*, an appellation given in Hindoostan, or the empire of the Mogul, to princes descended from those that ruled there before the conquest of the Moguls; who exercised all rights of sovereignty, only paying a tribute to the Great Mogul, and observing the treaties by which their ancestors recognized his superiority.

There are some rajahs who still retain a more independent sovereignty in the mountains: the Indians call them *rai*; the Persians, plurally, *raian*: our travellers *rajahs*, or *rajias*. These have under their command soldiers, called *rajapools*, or persons descended from rajahs, who are a robust and brave people, and who enter into the service of those

who will pay them. The Great Mogul has several of these rajahs in his service.

The chief lords of the Moguls, viz. the vice-roys, governors of provinces, and chief ministers of state, F. Catterow observes, are called *ombras*; and the idolatrous rajahs, or Indian lords who governed petty states before the conquest of their country, held the same rank at court with the *ombras*.

All the difference was, that the children of the rajahs succeeded their fathers in the show of the sovereignty left them; whereas the children of the Mahometan lords lost all in losing their fathers.

The Indians account four ages from the beginning of the world: and in the second, which lasted 1,296,000 years, they hold the rajahs or *kehatriys* had their rise; a noble cast, though inferior to the Bramins. Vice then, they say, began to creep into the world: men only lived to 300 years, and their stature was reduced, &c.

RAIA, the *Ray*, in *Ichthyology*, a genus of fishes of the order Chondropterygia, of which the generic character is, that it has five oblique spiracles on each side, placed beneath the neck; the head is small, pointed, and not distinct from the body; the mouth is beneath transverse, toothed; the body is broad, thin, and flat.

The individuals of this genus are all inhabitants of the sea only: they keep at the bottom, and in winter cover themselves with sand and mud: they feed on testaceous animals, fish, or any animal substances which they may happen to meet with. They grow to a large size, sometimes exceeding 200lbs. in weight. The females are the larger, and produce their young alive, only one at a time, which, like the shark tribe, are inclosed in a quadrangular, black, horny shell, the corners of which end in slender incurved points, but not extending into long filaments, like those of the shark: the eyes are half covered with a thin membrane, oblong, placed on the upper part of the head: above these, in the place of nostrils, is a broad fulcus or groove, divided by a reticulate membrane, consisting of crested folds, and closed with a valve: behind this fulcus are two small semilunar orifices: the tongue is very broad, short, and smooth. The ventral fins are covered with a thick skin, and surrounding the body; the ventral at the base are connected with the anal; the flesh is generally eatable; the liver is large, and producing a great quantity of pure oil.

Of this genus there are nineteen species, divided into three sections: viz. A, comprising the electric ray, or torpedo and skates: these have sharp teeth. B, including the sting-ray and thornbacks, having obtuse teeth. And C, which are denominated uncertain, comprising five species, which inhabit the Red sea, or about the Cape of Good Hope, but which have not yet been sufficiently examined.

Section A.—*With sharp Teeth.*

Species.

* TORPEDO; Electric Ray. The body of this fish is entirely smooth and flat. The species inhabits the Mediterranean, and grows to a large size: some have been taken that have weighed from 60 to 80lbs. each, but the average weight is less than 20lbs. It is of a dirty clayish colour; the head and body are round, and but indistinctly separated. The body is extremely thin; behind the eyes are two wide foramina, which have been supposed to be intended by nature for conveying sound; they are beset with six cutaneous fingers on their inner circumference, and communicate with the mouth. The torpedo can live about twenty-four hours out of the sea, and a short time longer, if put into fresh water;

water; it inhabits those places where the bottom is sandy, and buries itself superficially by flinging the sand over its back with a sort of vibration, which it gives to its extremities. It is in this situation that the torpedo astonishes and terrifies the unwary passenger, who inadvertently treads upon it, by the exertion of its electrical or benumbing faculty. This power is serviceable to the animal in two important respects; as a means of defence against voracious fishes, and as a method by which he is enabled to procure his subsistence from among the smaller tribes; for the former, when electrified, are deprived of all possibility of seizing their prey; and the latter, after having unwarily approached the torpedo, and received the shock, are incapable of making their escape. (See TORPEDO.) The food of the torpedo is furmulletts and plaice; the former are so swift, that it is impossible for the torpedo to take them by pursuit, and as this fish has been found in its stomach, it is presumed that it was taken by means of the electrical shock. The torpedo has been taken off Pembroke, at Torbay, and near Waterford in Ireland. It is caught like other flat fish, with the trawl, and is commonly found in water forty fathom deep, in company with other species of this genus.

* **BATIS**; the Skate. This species is varied; the middle of the back is smooth; the tail is beset with a single row of spines. It inhabits the European ocean, and is thought to be the largest fish of the genus: the body above is cinereous, sometimes with a few black lines, beneath white, with waved lines of black dots; round the eyes are numerous small, hooked spines; in the males the fins are full of spines. Of all the larger fishes, the skates are the most numerous, and their numbers are in a great measure owing to their size, and to the protection afforded them by those frightful spines which nature has afforded them. There is not one of the rapacious tribes, excepting, perhaps, the cachalot and white shark, that has a swallow sufficiently large to receive them, and even these are probably deterred from their purposes of destruction by the armour with which their prey is covered. Of some the size is such as to defy all powers of destruction which even the shark himself possesses. In England some of the species have been taken, weighing upwards of two hundred weight, but even this is far inferior to their enormous bulk in other parts of the world. Near the island of Guadeloupe, a ray was killed more than twenty-five feet long, and almost fourteen broad. After all, the fishes of this tribe probably attain a much larger size than that of any individual which has ever yet been examined. It is only the smallest of the kind that approach the shores; the largest continue for ever prowling at the bottom in the unfathomable caverns of the ocean, where they continue perhaps to grow for a century.

The fishes generate in March and April, at which time they swim near the surface of the water, several males pursuing one female. The females cast their *purfes*, as they are called, in May, and continue to produce till September: they are very prolific, not less than three hundred eggs having been found in the body of a single female. The rays generally frequent those parts of the sea where the bottom is black and muddy, where they devour every thing indiscriminately, but they are more delicate with regard to a baited hook. They devour any putrid substances whatever, but if the bait has been taken up and suffered to lie for any time in the open air, they will not touch it; they appear to perceive the line, and to dread it; but the impulse of hunger overcomes their caution, and even though they perceive the danger, if thoroughly hungry, they devour the bait, as if regardless of the consequences. See SKATE.

OXYRINCHUS; Sharp-nosed Raia. Varied; middle of

the back with ten spinous tubercles. This is similar in shape to the skate, but with a longer and sharper snout: the colour of the whole upper part is cinereous, with several pale or whitish spots, intermixed with a few slight dusky streaks or variegations; beneath it is white, with dusky or blueish streaks; down the back and tail runs a single row of spines, and a few others are placed about the region of the eyes: the sides of the tail are also sometimes furnished with a row of smaller or weaker spines than those on the upper part; the eyes are large, as is also the mouth. This species, like the skate, sometimes, but not often, is taken of a very considerable size. It is a native of the Mediterranean and Northern seas.

MIRALETUS. This species has a smooth belly and back: it has spines near the eyes, and a triple row of them on the tail. It inhabits the Mediterranean; the body above is marked with an ocellate spot.

* **FULLONICA**; the Fuller Ray. The back is covered with spines; the eyes with a single row; pectoral fins and tail with a triple row. It inhabits the European seas; grows to a large size; the body above is cinereous, with numerous black spots; beneath it is white. The snout of this fish is short and pointed; the nictitant membrane is fringed; the teeth are small and sharp; and the tail is slender. It has been thought by some authors that this is only a variety of the next species.

* **RUBUS**; Rough Ray. The back of this species has a single spine; and the tail is beset with a triple row of spines. This is greatly allied to the thornback, but covered with more numerous spines, every part of the skin on the upper surface being mucicated with sharp curved aculei of different sizes: of these, one row of the largest runs down the middle of the back, and three, or sometimes five, along the tail; others are dispersed about the eyes and the flaps of the pectoral fins: the general colour is a yellowish or whitish-grey, sometimes variegated with dusky or brownish clouds and streaks; the under side is white, and beset with very numerous scattered spines, but less strong than those on the upper side. It is about the size of a thornback. Mr. Pennant mentions one that measured nearly three feet from the nose to the tip of the tail. It is a native of the Mediterranean and other seas.

B. — Teeth obtuse.

Species.

SEPHEN. Body nearly round; tail twice as long as the body, winged beneath, and with two long spines above, serrate on each side. It inhabits the Red sea, and is sometimes so large, as to reach three yards across; body above brown, with three rows of large hemispherical tubercles down the middle of the back; beneath it is quite flat and smooth, and it is of a reddish-white. It is from the skin of this species that the beautiful substance called *Galuchat* is prepared by the French, and which, being coloured with blue, green, or red, according to the fancy of the article, and afterwards polished, is so frequently used for various kinds of cases, telescope tubes, &c. For this purpose the smaller or younger specimens are preferred; the tubercles in the more advanced or full-grown animals being too large.

There is a variety of this species: the length of the specimen described by Dr. Ruffell was about $9\frac{1}{2}$ inches; the tail is about two feet nine inches long; the colour of the whole animal is a dull leaden above, with a deep blue tail; beneath it is dusky white; on the middle of the back there are only two pearl-formed tubercles instead of three; the tail is furnished with a sharp spine and a fin beneath. It is a native of the Indian seas.

AQUILA. The body is smooth; the tail is pinnate, with a long ferrate spine. This species is of a rhomboidal shape, but with a considerable dilatation: the pectoral fins approach to a subfalcated form: the colour is cinereous above; pale or whitish beneath: the head is rather large, and the snout produced: the eyes are large and prominent, with yellow irides: the tail is long, slender, sharp-pointed, and furnished about the middle with a spine similar to that of the sting-ray. This species grows to a very great size, sometimes measuring ten, twelve, or even fifteen feet in length, and weighing upwards of three hundred pounds. It is found in the Mediterranean, Atlantic, and Indian seas, and is said to swim in a slower manner than most other rays; it preys on smaller fishes, and is supposed to strike and kill, or at least disable its prey with the caudal spine: when taken, it is observed to vibrate the tail with great strength and rapidity in all directions. It is not reckoned among the edible fishes; but the liver, which is very large, is said sometimes to be eaten, though it is more frequently used for the purpose of preparing from it a clear oil, which it affords in great plenty.

* **PASTINACA**; Sting-ray. The body of this species is smooth; its tail has a long sharp spine, ferrate on the fore part, and another on the back: there are two other varieties, of which the one has a smooth body; the back is beset with two spines, ferrate on the fore part; the body of the other is covered with spots.

This species is described as having a body somewhat approaching to the ovate, the pectoral fins less pointed than in some other species of this division. The snout is pointed; the body more convex than usual; the colour of the whole animal above of a yellowish-olive, but the back is sometimes found to approach to a blueish-brown; beneath it is whitish; the tail is of a considerable length, and without a fin, very thick at the base, and gradually tapering to the extremity, which is very slender: near the middle it is armed, on the upper part, with a very long, flattened, and sharp-pointed bone or spine, finely ferrated in a reversed direction on both sides: with this the animal is capable of inflicting very severe wounds on such as incautiously attempt to handle it; and it answers the purpose both of an offensive and defensive weapon. This weapon is annually cast, and as it frequently happens that the new spine has arrived at a considerable size before the old one has been cast, the animal is occasionally found with two, in which state it has been sometimes erroneously considered as a distinct species. This fish is said not to grow to a very large size. It is found in the Mediterranean, Atlantic, and Indian seas, and is numbered among the edible rays. On account of the danger attending the wounds inflicted by the spine, it is usual with the fishermen to cut off the tail as soon as the fish is taken. In some countries it is said to be illegal to sell the fish with the tail adhering to it.

It was formerly thought that the spine of the fish possessed a venomous quality, by infusing into a wound made by it some very active poison; this is now proved to be completely erroneous, and the effects sometimes produced by it arise entirely from the deepness of the puncture and laceration, which, if taking place in a tendinous part, or among the larger nerves and blood-vessels, have often proved fatal. It may not be amiss to observe, that some ancient writers have decanted upon the effects of this animal's powerful weapon in terms of considerable luxuriance; it was supposed to be not only poisonous in the living animal, but to preserve its poison when taken from the fish, and affixed to the head of an arrow or a spear; it was said even to destroy the most healthy and flourishing plant by its touch, and

even to cause trees to die by striking the bark with its point. It formed the head of the fatal spear presented by Circe to her son Telegonus, by which he was rendered superior to his enemies, and with which he, at length, unconsciously, slew his father Ulysses. The general habits of this species are similar to those of the rest of the genus, often lying flat, and in ambuscade on the soft mud at the bottom of the shores which it frequents, and seizing its prey by surprise; at other times it will pursue it through the depths of the ocean.

* **CLAVATA**; Thornback. The body of this species is spinous; the teeth tuberculate; across the belly is a strong femilunar cartilage. This species grows to a very considerable size, though rarely equal in magnitude to the skate already described; in its general appearance it resembles that fish, but is somewhat broader in proportion, and is readily distinguished from the skate by the very strong, curved spines with which its upper surface is covered; these are most conspicuous down the middle and on each side of the back, where four or six, of much larger size than the rest, are generally seen; the remaining parts being furnished with many scattered spines of a smaller size, intermixed with still more minute ones, and the whole skin is of a rough, or shagreen-like surface; the back is marked with an uncertain number of pale or whitish round spots of different sizes, and which are commonly surrounded with a blackish or dark coloured edge; these spots are said to be caused by the shedding of the spines at different intervals; along the middle of the back runs a single row of strong spines, continued to the tip of the tail; the colour of the skin is a brownish-grey, with irregular blackish or dusky variegations; the under part is white, with a light cast of flesh-colour, and about the middle of the body, as well as on the fins, are disposed several spines similar to those on the upper side, but less strong. The thornback is an inhabitant of the Mediterranean and other seas, and is held in some esteem as food, though not considered equal to the skate in goodness.

RHINORATOS. Body long, tapering; snout lengthened. This is reckoned a very remarkable species, and is thought to connect in some degree the genera of raia and squalus, the body being much longer than in the preceding kinds of ray; the snout is lengthened, but not very sharp; and the body, which is moderately convex above, and flat beneath, gradually tapers from the shoulder to the tail, which is furnished above with two fins, of an oblong shape, and situated at a considerable distance from each other: the tip of the tail is also dilated into an oblong fin. The colour of the whole fish is of a dull earthy brown, paler beneath, and the skin is every where roughened by minute tubercles. This fish is said to grow to the length of about four feet, and is a native of the European seas. It is very frequently seen about the coasts of Naples.

DJIDDENSIS. Tail-fin two-lobed; spines in a triple row at the beginning of the back, and afterwards in a single row; the first dorsal fin is above the ventral. It inhabits the Red sea, and is about two yards long. The body is a little rough, and of a pale ash colour; above it is varied with whitish spots; beneath it is whitish; behind the vent are a few brown and white stripes.

LYMMA. Body oval, smooth, testaceous, with blue spots; pinnate tail with a single spine. It inhabits the Red sea; is hardly a foot long; the spots oval, unequal, beneath whitish. It is much allied to the eagle-ray, and is of a reddish-brown colour above; the tail is somewhat longer than the body, marked above, for half its length, with two longitudinal blue stripes, and is furnished about the middle with one, and sometimes with two, large and ferrated spines, which

which are covered at their base by a blueish-brown skin; the under part of the body is pale or whitish.

ARNAK. Body orbicular, silvery; tail round, without a fin, and furnished with two spines. It inhabits the Red sea; the teeth are granulate.

C. Uncertain.

OMMESSCHERIT. Tail round and spotted. It inhabits the Red sea, and very much resembles the *R. pastinaca*.

TAJARA. Tail round; body beneath snowy. It inhabits the Red sea. When just taken, it beats violently with its fins.

SCHOUKIE. Body with a few remote spines. It inhabits the Red sea. The Arabians make scabbards for their swords out of its skin.

MULA. Beneath snowy; tail round, variegated. It inhabits the Red sea, and approaches the shores by night. The spine on its tail inflicts a dangerous wound.

RAPENSIS. Back with a single fin; the tail is short, pinnate at the end; the body is smooth and unarmed; and the snout is a little obtuse. It inhabits near the Cape of Good Hope, is shaped something like the torpedo, except that it has a fin on the back. The body is small and orbicular; above it is convex, beneath flat.

RAJABARRY, in *Geography*, a town of Bengal; 10 miles S. of Dacca. N. lat. $23^{\circ} 24'$. E. long. $90^{\circ} 36'$.

RAJACOTTY, a town of Thibet; 60 miles N.N.W. of Sirinagur.

RAJAGUNGE, a town of Assam; 16 miles S. of Gentiah.

RAJAGUR, a town of Hindoostan, in Bahar; 35 miles W.S.W. of Gayah.—Also, a town of Hindoostan, in Guzerat; 10 miles N.E. of Champaneer.

RAJAHUN, a town of Hindoostan, in the circar of Cicacole; 12 miles W. of Cicacole.

RAJAKERA, a town of Hindoostan, in the province of Agra.

RAJAMUNDRY, a circar of Hindoostan, bounded on the N. by the circar of Cicacole and Golconda, on the E. by the bay of Bengal, on the S. by the circar of Ellore, and on the W. by Golconda. It is crossed by the Bain Gonga from N. to S.—Also, the capital of the above-mentioned circar, situated between Ellore and Cicacole, on the Godavery. Its principal riches consist of forests of teak-wood. N. lat. 17° . E. long. $81^{\circ} 57'$.

RAJANAGUR, a town of Bengal; 25 miles S. of Dacca.—Also, a town of Hindoostan, in the circar of Rajamundry; 7 miles N.E. of Rajamundry.

RAIANIA, in *Botany*, so called in honour of our immortal naturalist, the Rev. John Ray, the most accurate in observation, the most philosophical in contemplation, and the most faithful in description, amongst all the botanists of his own, or perhaps any other, time. His life will be given hereafter, in its proper place. Plumier, who established this genus, finding the name *Raia* preoccupied by zoologists, contrived to call the plant *Jan-Raia*; which Linnæus turned about into *Rajania*, still retaining the idea of the Christian name, combined with the other. But such an idea is ludicrous to English ears, and is happily not, in general, perceived. We presume to alter the orthography in one letter, writing the word as it is always pronounced, and deducing it regularly from the Latin *Raius*, by which name the person commemorated is known all over the literary world.—Plum. Gen. 33. t. 29. Linn. Gen. 525. Schreb. 692. Willd. Sp. Pl. v. 4. 788. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 5. 391. Juss. 43. Lamarck Illustr. t. 818. Gærtn. t. 14.—Class and order,

Dioclea Hexandria. Nat. Ord. *Sarmentacea*, Linn. *Ajpa-ragi*, Juss.

Gen. Ch. Male, *Cal.* Perianth bell-shaped, in six deep, oblong, pointed segments, most spreading in their upper part. *Cor.* none. *Stam.* Filaments six, bristle-shaped, shorter than the calyx; anthers simple.

Female, *Cal.* Perianth superior, of one leaf, bell-shaped, in six deep segments, permanent, withering. *Cor.* none. *Pist.* Germen inferior, compressed, with a prominent border at one side, three-celled; styles three, the length of the calyx; stigmas obtuse. *Peric.* Capsule membranous, of three cells, without valves, crowned by the calyx; two of the cells barren, almost obliterated, without wings; the third fertile, compressed, extended into a very large, half-ovate, membranous wing. *Seed* solitary, nearly elliptical, compressed.

Eff. Ch. Male, Calyx in six deep segments. Corolla none. Female, Calyx in six deep segments. Corolla none. Styles three. Capsule membranous, with one wing. *Seed* solitary.

Section 1. Leaves simple.

1. *R. hastata*. Halberd-leaved Raiania. Linn. Sp. Pl. 1461. (Jan-Raia scandens, folio oblongo, angusto et auriculato; Plum. Gen. 33. Bryonia fructu alato, foliis auriculatis; Plum. Amer. 84. t. 98.)—Leaves hastate; somewhat heart-shaped at the base.—Gathered by Plumier, about Port-de-paix in the island of Hispaniola. *Root* perennial, sometimes large and ovate; sometimes four or five inches long, and two thick, round at each end, like a sausage. Its substance resembles that of a radish, without any internal fibres; the bark thin, ash-coloured, a little rugged and warty; the flesh very white, tasting like a bean. This root throws up only one very slender, long, climbing, smooth, knotty stem, thickest at the base, where it is accompanied by several fibrous radicles. We presume it to be annual. *Leaves* scattered, spreading, on short stalks, smooth and membranous, about three inches long; heart-shaped, dilated, abrupt, and seven-ribbed at the base; then suddenly elongated into a nearly linear, entire, central, three-ribbed lobe, bluntish, with a small point; the under side paler, and rather downy. *Stipulas* in pairs, awl-shaped, minute. *Flowers* small, whitish, in simple, axillary, drooping clusters. *Bractæas* minute, ovate, acute, solitary at the base of each partial stalk. *Fruit*, as Plumier says, like half that of a maple-tree, of a silvery hue when young, but afterwards tawny.

2. *R. cordata*. Heart-leaved Raiania. Linn. Sp. Pl. 1461. *Ait. n. 1.* (Jan-Raia scandens, foliis tamni; Plum. Ic. 148. t. 155. f. 1.)—Leaves ovate; somewhat heart-shaped at the base; seven-ribbed.—Native of the West Indies, from whence it was sent to Kew garden, in 1786, by Mr. Alexander Anderson. It flowers in the stove in July, and we cannot but wish some accurate botanist would publish a good figure and description of the plant, out of respect to its name. Plumier represents the habit of the *root*, *stem*, &c. much like the foregoing; but the *leaves* are regularly ovate, pointed, more or less heart-shaped at their base, and furnished with seven ribs continued from that part to the point. These ribs are connected by numerous transverse veins. *Inflorescence*, *flowers*, and *fruit*, much as in *R. hastata*, but having seen no specimen, we can say nothing respecting the *stipulas* or *bractæas*, none of which are noticed in the plate.

3. *R. ovata*. Ovate-leaved Raiania. Swartz Ind. Occ. v. 1. 638. Mart. Mill. Dict. n. 4.—“Leaves ovate, pointed, three-ribbed.”—Native of bushy places, on the hills of Hispaniola. *Stem* shrubby, twining, thread-shaped, subdivided;

subdivided; with slender, smooth, leafy branches. *Leaves* rather distant, stalked, smooth on both sides, pointed, entire, three-ribbed, veiny; ovate at the base. *Footstalks* round, smooth, often as long as the leaves. *Clusters* axillary, numerous, longer than the leaves, slender, many-flowered, rather zigzag. *Flowers* dioecious; the males in compound *clusters*; females in simple ones, all stalked, and turned toward one side. *Corolla* very minute, yellowish-green in the male, reddish in the female blossoms. *Capful* compressed, with an ovate, falcate, membranous wing. *Swartz.*

4. *R. angustifolia*. Narrow-leaved Raiania. *Swartz* Ind. Occ. v. 1. 639. Mart. n. 3.—“*Leaves* linear-lanceolate; rounded at the base, three-ribbed.—Native of extremely dry bushy places, in the west part of Hispaniola, where it climbs upon high trees, flowering in May. *Root* annual. *Stem* thread-shaped, round, twining, flaccid, subdivided, smooth. *Leaves* nearly a span long, entire, three-ribbed, veiny, smooth. *Footstalks* smooth, red, twisted according to the direction of the stem. *Clusters* axillary, in pairs, the length of the leaves, pendulous, slender, many-flowered; the *flowers* very minute, nearly sessile, red, polygamous, five or six on each of the alternate partial stalks, all leaning one way. *Bractes* very minute, acute, blood-red, under the flowers. On some plants the latter are entirely male, with six nearly sessile *anthers*; on others all hermaphrodite, with six perfect *stamens*, a triangular oblique *germen*, no *style*, but three minute *stigmas*. *Capful* as in the rest of the species. *Swartz.*

5. *R. quinquefolia*. Five-leaved Clustered Raiania. *Linn.* Sp. Pl. 1462. (Jan-Raia scandens quinquefolia; *Plum.* Ic. 149. t. 155. f. 2.)—Leaves five together at each joint, elliptic-oblong. *Clusters* lateral, between the joints.—Native of the West Indies, but hitherto observed by *Plumier* only. This seems to have the habit of all the foregoing, except that the *stem* has tumid joints, at each of which stand five elliptic-oblong, obtuse, entire, three-ribbed *leaves*, about three inches long, on short *footstalks*. The *clusters* are represented not axillary, as in the others, but lateral and alternate, from the spaces of the *stem* between the joints.

Section 2. *Leaves compound.*

6. *R. quinata*. Five-leaved Umbellate Raiania. *Thunb.* Jap. 148. Mart. n. 6.—Leaves five on a common stalk, emarginate. Umbels axillary.—Observed by *Thunberg* about Nagasaki and in Kofido, in Japan, flowering in April and May. The Japanese call this plant *Fagi Kadfura*, and *Akebi*. *Stem* twining, round, smooth, ash-coloured, branched. *Leaves* several together, axillary, stalked, smooth, of five separately stalked, umbellate, ovate, entire *leaflets*, each from three-quarters of an inch to an inch and a half long, emarginate with a point. *Common footstalks* thread-shaped, smooth, two inches or more in length; *partial* half as long as the finger nail. *Flowers* in umbels, from the same buds as the leaves, on slender stalks as long as the footstalks; *partial* stalks capillary, the length of the nail. This species differs from the last in having compound *leaves*, and umbellate *flowers*. *Thunberg.*

7. *R. hexaphylla*. Six-leaved Clustered Raiania. *Thunb.* Jap. 149. Mart. n. 7.—Leaves six on a common stalk, oblong, acute. *Flowers* racemose.—Native of the country of Fakoña, in Japan, among bushes, flowering in April. Its vernacular names are *Akebi*, *Abe Kadfura*, and *Tsu So*. The *stem* is round, striated, smooth, climbing. *Leaves* alternate, smooth, six on a stalk, umbellate, on slender partial stalks, oblong, acute, entire, veiny, two inches long; pale at the back. *Common footstalks* round, bent, three or four

inches long, swelling at each extremity. *Flowers* in axillary clusters, snow-white. Differs from *R. quinata* in having mostly six leaflets on a stalk, which are acute, reticulated with veins at the back, and larger than in that species. The *flowers* moreover grow in clusters, not umbels.

RAJAPILLA, in *Geography*, a town of Hindoostan, in Myfore; 16 miles N.N.E. of Anantpour.

RAJAPORUM, a town of Hindoostan, in Barramaul; 35 miles S. of Darempoury.

RAJAPOUR, a town of Hindoostan, in the circar of Hillar; 48 miles W. of Hillar.—Also, a town of Hindoostan, in the circar of Gohud; 10 miles W. of Jauli.—Also, a sea-port of Hindoostan, in Concan, where the English and French had formerly factories. The place has a good harbour, but it is not now frequented; 6 miles N. of Geriah.—Also, a town of Bengal; 16 miles S. of Silhet.—Also, a town of Bengal; 50 miles N.W. of Burdwan.—Also, a town of Hindoostan, in Bahar; 27 miles W. of Arrah.

RAJARAJESWARI, in *Mythology*, a name of the Hindoo goddess Parvati. It means, in Sanscrit, consort of the lord of the king of kings. In the masculine it is Rajarajswara, and is then a name of her lord Siva. See that article.

RAJARSHI, is one description of saint or sage, of whom four sorts are comprehended in the more general term of Rishi. Rajarshi means a royal sage, and is the lowest of the four; the Devarshi, or divine sage, being, as may be supposed, where Brahmans are the givers of dignity, the first. See more hereon under MAHARSHI and RISHI.

RAJASEE, in *Geography*, a town of Hindoostan, in the circar of Gohud; 10 miles S.W. of Datteah.

RAJASERAI, a town of Hindoostan, in the circar of Sirhind; 17 miles E.S.E. of Sirhind.

RAIBACH, a town of Bavaria, in the territory of Rothenburg; 7 miles S. of Rothenburg.

RAIBAUG, a town and circar of Hindoostan, in Viapour; 23 miles S. of Masritch. N. lat. 16° 35'. E. long. 74° 52'.

RAIBOLINI, FRANCESCO, in *Biography*. See FRANCIA, IL.

RAJBULHAUT, in *Geography*, a town of Bengal; 30 miles S. of Burdwan. N. lat. 22° 45'. E. long. 88° 7'.

RAICAN, a town of Persia, in the province of Irak; 15 miles N.E. of Hamadan.

RAICZ, a town of Hungary; 6 miles S.S.E. of Bolesko.

RAIDURGAM, a town of Hindoostan, in the Carnatic; 15 miles W. of Tricolore.

RAIDY, a town of Bengal; 25 miles S.W. of Doefa.

RAIE, a town of Asiatic Turkey, in the province of Diarbekir; 118 miles S.W. of Diarbekir.

RAJEEATA, a town of Hindoostan, in Guzerat; 78 miles W. of Gogo.

RAJEE-BEDUROO, a town of Hindoostan, in Lahore; 27 miles E. of Jummo.

RAJEGAUT, a town of Bengal; 24 miles S.S.E. of Islamabad.

RAJEGUR, a town of Bengal; 26 miles S. of Burdwan.—Also, a town of Hindoostan, in the circar of Gangpour; 23 miles S.W. of Gangpour.—Also, a town of Hindoostan, in Mewat; 20 miles E. of Cotputly.—Also, a town of Hindoostan, in the circar of Gohud; 27 miles S.W. of Narwa.—Also, a town of Hindoostan, in the circar of Bundelcund; 22 miles S.E. of Chatterpour.—Also, a town

a town of Hindoostan; 20 miles E.S.E. of Allahabad. N. lat. $24^{\circ} 49'$. E. long. $80^{\circ} 17'$.

RAJEGUSDAR, a town of Hindoostan, in Lahore; 35 miles E.N.E. of Behnbur.

RAJEHAUT, a town of Bengal; 16 miles N.W. of Biffunpour. N. lat. $23^{\circ} 13'$. E. long. $86^{\circ} 40'$.

RAJEMAL, a circar of Bengal, bounded on the N. by Purneah, on the E. by Purneah, Mauldah, Dinagepour, and Rajeshly, on the S. by Sultanabad, and on the W. by Hindooa and Boglipour.—Also, the capital of the above circar, lying on the W. bank of the Ganges, nearly in the parallel of Mauldah, and about 20 miles from it; at the foot of the chain of hills which projects into the river at Sielygully and Terriagully. It is in a ruinous state, although not above $1\frac{1}{2}$ century ago the residence of the viceroy; and has hardly the population of an ordinary market-town at present. Its situation is romantic, but not pleasant; for in Hindoostan, the hills and eminences being always covered with wood, that beautiful swelling of the ground, which is so justly admired in European landscapes, is lost; and the fancy is presented at best with nothing beyond a wild scene; which can only be relished by being contrasted with soft and beautiful ones. It is more than thirty miles above the head of the delta of the Ganges, and therefore M. d'Anville placed it erroneously by assigning its situation at this place. N. lat. $25^{\circ} 2'$. E. long. $87^{\circ} 56'$.

RAJEMATCHY, a town of Hindoostan, in Vifiapour; 37 miles N.W. of Poonah.

RAJEMUNGALUM, a town of Hindoostan; 16 miles S. of Tinevelly.

RAJETEA, one of the South-sea islands, named also *Ulietea*; which see.

RAJETPOUR, a town of Bengal; 15 miles S. of Rogonatpour.

RAJEWICE, a town of Lithuania; 42 miles S.S.E. of Brzesc.

RAIGIRI, a town of Hindoostan, in Golconda; 10 miles S.E. of Beder.

RAIGUR, a town of Hindoostan, in the circar of Sumbulpour; 15 miles N. of Sumbulpour.

RAJIK, a town of Syria, on the Euphrates; 18 miles S. of Bembig.

RAIL, in *Architecture*, is applied variously; particularly to those pieces of timber which lie horizontally between the pannels of wainscot, and over and under them.

The word is also applied to those pieces of timber which lie over and under ballusters in balconies, staircases, &c.

Also, to the pieces of timber that lie horizontally from post to post in fences, with pales or without. See FENCE.

RAILS, in a *Ship*, are long narrow pieces of fir, or oak, with mouldings of regular members of architecture flruck on them, which are fastened, or sometimes wrought from the solid plank, as ornaments to the ship's sides. The former are now discontinued in the navy, as they were found to rot the sides very much; the latter, wrought from the solid plank, are used in merchant ships. The rails of the head and stern are pieces of oak timber handsomely wrought with mouldings. The lower rail along the side is named the *waist-rail*, and the next above it the *sheer-rail*, which are generally placed parallel to the top timber line, the sheer-rail with the top of the side amidships, and the waist-rail about twenty inches below it; the rails next above and parallel to the sheer-rail are called *drift-rails*, and the rails above the plank-sheer, if any, the *fife-rails*. The rails of the head are distinguished by the *upper* or *main-rail*, the *middle* and the *lower-rail*; and the rails of the stern take their names from the parts to which they are fixed, as the *tuck-rail*, *lower*

counter-rail, *upper counter-rail*, *foot space-rail*, *breast-rail*, *taffarel-rail*, and *taffarel fife-rail*. (See Plate I. *Ship-building*.) To these may be added the thwartship pieces of the framing of the great cabin bulk-heads.

RAILS of the *head* are certain curved pieces of timber, extending from the bows on each side to the continuation of the ship's stem, to support the knee of the head, and the ornamental figure fixed upon it.

RAIL, or *Water-Rail*, in *Ornithology*, the name of the *rallus aquaticus* of authors, which is a bird of a long slender body, with short concave wings. The bill is slender, slightly incurved, and one inch three quarters long: the upper mandible black, edged with red, the lower orange-coloured; the irides red; the head, hind-part of the neck, the back and covert of the wings and tail are black, edged with an olive-brown; the base of the wing is white; the quill-feathers and secondaries dusky; the throat, breast, and upper part of the belly, are ash-coloured; the sides under the wings, as far as the rump, finely varied with black and white bars; the tail is very short, consisting of twelve black feathers; the ends of the two middle tipt with rull colour; the feathers immediately beneath the tail white; the legs are placed far behind, and are of a dusky flesh colour; the toes very long, and divided to their origin: though the feet are not webbed, it takes the water, will swim on it with much ease, but is often observed to run along the surface. It delights less in flying than in running, which it does very swiftly along the edges of brooks covered with rushes. When it runs, it every now and then flirts up its tail, and in flying hangs down its legs. Pennant.

This bird, says Mr. Pennant, is properly *sui generis*, agreeing with no other, but forming a separate tribe; though M. Briffon and Linnæus place it with the land-rail, and Mr. Ray with the water-hens. It is a well-tasted bird.

RAIL, *Land*, the *rallus crex* of Linnæus, is a migrating bird, with a short, strong, thick bill; always found among corn, grass, broom, or furze. It leaves this kingdom before winter. They have long legs, and a singular note, resembling the word *crex*, often repeated. The feathers on the crown of the head, hind part of the neck, and the back, are black edged with bay colour; the coverts of the wings of the same colour, but not spotted; the tail is short and of a deep bay, the belly white, and the legs ash-coloured. They are in greatest plenty in Anglesea, where they appear about the 20th of April, supposed to pass over from Ireland, where they abound. They are found in most of the Hebrides, and the Orkneys. Pennant.

RAILING, in *Rural Economy*, a sort of fence constructed with posts and rails. It is often made use of in protecting young hedge fences, from the cropping of cattle or other animals. Any sort of coarse timber does very well for this last purpose, such as outside planks, and the boughs or loppings of timber plantations. See FENCE.

RAILLERY, as Dr. Johnson hath defined it, denotes slight satire, or fatirical merriment; and a beautiful writer compares it to a light which dazzles, and which does not burn. It is sometimes, what it always ought to be, innocent and pleasant, but it is too frequently offensive. Rail-lery is of various kinds; serious, severe, and good-humoured; there is a kind which perplexes, a kind which offends, and a kind which pleases.

It has been justly observed, that in order to rally well, kindness should prevail in every thing that is said, as the character of a friend should be maintained to warrant freedom with a person who is addressed, especially in this way. Allusions to past follies, and hints that tend to revive what a person wishes for ever to forget, should never be introduced

as subjects of railery. It is below the character of persons of humanity and good breeding, to indulge mirth, while any one in the company is suffering, as the effect of that mirth, pain and mortification.

RAILWAY, *Tram or Dram-road, or Waggon-way*, in *Rural Economy*, a track constructed of iron, stone, timber, or other material, upon the level surface of an inclined plane, or other situation, for the purpose of diminishing friction, and thus serving for the easy conveyance of heavy loads of any kind of articles. See *Plate IV. Canals, figs. 31 to 35.* See also **CANAL**.

It has been remarked, that railways have hitherto been confined, almost exclusively, to coal-works, and other mines; and that inventions, whose only recommendations are simplicity and usefulness, are often suffered to lie long in a state of public neglect; while others, perhaps, of no real utility, but of more imposing aspect, and being pertinaciously blazoned forth by interested or blinded partisans, are readily adopted; and bask, for a while, in the sunshine of public favour. The time has, however, at length arrived, when carriages moving on level surfaces, or on gently inclining planes, with little friction, and *without* obstructions, are fast spreading over the face of the country. It has been observed that there may be many lime-works, as well as other sorts, from which railways may be laid, in different directions, with great benefit to their proprietors and the surrounding neighbourhoods in general.

With the view of diminishing horse labour, it has been suggested by Dr. Anderson, in his *Recreations in Agriculture*, that where internal canals cannot be established, this may be effected, and intercourse facilitated, by means of railways, which have not yet been introduced into general practice. It is further stated, that they were first solely employed for transporting coals to a moderate distance from the pits, to the places where they could be shipped, being universally made of wood. And long, says he, had they been applied to this use, without any idea having been entertained that they could be employed for more general purposes. By degrees they were, however, carried to a farther extent; the scarcity of wood, and the expence of their repairs, suggested the idea of employing iron for the purpose of improving these roads. At the first, flat rods of bar-iron were nailed upon the original wooden rails, or as they were technically called, *sleepers*; and this, though an expensive process, was found to be a great improvement. But the wood on which these rested being liable to rot and give way, some imperfect attempts were made to make them of cast iron, but these were found to be liable to many objections, until the business was taken in hand by Mr. Outram, engineer, at Butterly Hall, Derbyshire, who contrived at the same time, so far to diminish the expence, and improve the strength of the road, as to bring them to a degree of perfection, that no one who has not seen them can easily conceive could have been done. And it is added, that this having been carried into execution in a few cases, and found to answer, has been improved upon and simplified by practice, till it is now brought to such a state of perfection as to have given proofs, that it admits of being carried much beyond the limits of what was for many years conceived to be possible, and to afford demonstrative evidence, that it may be in future employed to a wider extent still, to which no limits can be at present assigned or foreseen.

There are a great number of railways in Derbyshire, Shropshire, Lancashire, and many other parts of the country.

In the first of the above counties, there are railways of very different lengths; one of five miles in length, leading from the town of Derby to the collieries in the vicinity;

another, from the lime-stone rocks on the Cranford canal, called the Crick railway, which is about one mile and a half in length; a third from the Beggarlee colliery to the same canal, denominated Barber and Walker's railway, of similar length; a fourth from the lime-works in the neighbourhood of Boston, to the canal near Whaley bridge, termed the Peak-forest railway, which is about six miles in length; a fifth called the Marple railway, of about one mile and a half long, on the Peak-forest canal; sixthly, railways over Blifworth-hill near Nottingham, on the Grand Junction canal, which are three miles and a half in length, and constructed in a double manner; a seventh, which has the name of the Ashby de la Zouch railway, has four miles of double and eight miles of single rails. Some of these railways are formed in a very complete manner, especially those which have been made since the various improvements of them were introduced. They have been of prodigious utility and advantage to the county, both in regard to its agricultural improvements and its manufacturing interests and concerns.

These sorts of railway roads have likewise been introduced into many parts of the county of Salop, with vast benefit and success to the different interests of the district. They have here had a new application, in being employed for the purpose of conveying heavy weights from different levels on canals.

Speaking of the great utility of canals in the carriage of various articles in this county, it is observed by Mr. Telford, an able engineer, that another mode of conveyance has frequently been adopted to a considerable extent; which is that of forming roads by means of iron rails laid along them, upon which materials are carried in waggons, which contain from six to thirty hundred weight; experience, he thinks, has now convinced us, that in countries the surfaces of which are rugged, or where it is difficult to obtain water for lockage, where the weight of the articles of the produce is great in comparison with their bulk, and where they are mostly to be conveyed from a higher to a lower level, that in those cases, iron railways are in general preferable to canal navigation.

It is supposed, that on a railway well constructed, and laid with a declivity of fifty-five feet in a mile, one horse will readily take down waggons containing from twelve to fifteen tons, and bring back the same waggons with four tons in them. This declivity, therefore, suits well, when the imports are only one-fourth part of what is to be exported. If the empty waggons only are to be brought back, the declivity may be made greater; or an additional horse applied on the returning journey will balance the increase of declivity. If the length of the railway were to be considered, it may, it is supposed, without much inconvenience, be varied from being level to a declivity of one inch in a yard, and by dividing the whole distance into separate stages, and providing the number of horses suitable for each portion of railway, according to the distance and degree of declivity, the whole operation may be carried on with regularity and dispatch.

It is upon the whole believed, that this useful contrivance may be varied so as to suit the surface of many difficult countries, at a comparatively moderate expence. It may be constructed in a much more expeditious manner than navigable canals; it may be introduced into many districts where canals are wholly inapplicable; and in case of any change in the working of mines, pits, or manufactories, the rails may be taken up and laid down again in new situations, at no very great expence or trouble.

It is also further noticed, that some parts of this and the neighbouring counties, in which canals had once been intended

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intended to be formed, have since been looked over and examined with the view of having iron railways instead of navigable cuts; and in many cases this may be the most advisable and proper, particularly in all situations where difficulties arise in the constructing of navigable canals, or other sorts of works for water carriage.

The county of Lancaster, too, has a great many of these iron railways for the convenience, accommodation, and advantage of the different collieries, manufactories, and other works, where heavy loads are to be transported. The coal work near St. Helens, in the vicinity of Liverpool, has a double railway some miles in length; and at the iron-works of lord Belcarras, near Wigan, as well as his cannel coal pits near the same place, there are double railways of very considerable length. To the south of the town of Preston, at a small distance from Bamber bridge, there is likewise one communicating with the Lancaster and Kendal canal, which is also double and of great length; serving to convey the coals from the southern parts of the county to that canal, in order to their distribution in the northern parts, and the adjoining districts.

On the east side of the same county they also prevail in many places, and are found of the greatest use, being the means of dispatching much business in a ready manner and without much expence of labour.

The utility of these railways has been found to be extremely great in other coal-works and canals, where they are at present very extensively employed; and it has been suggested, that they may be applicable in other cases, as for shortening the team labour of a farm so as to bring it within one day's journey, where more than one were formerly necessary, by which a great saving in labour and expence may be made. Also, in rendering the business of lime works more easy and expeditious in different instances. It has likewise been hinted by Mr. Beatson, in the first volume of Communications to the Board of Agriculture, that they might be had recourse to on roads where there are unavoidable rises or falls, for taking up or letting down heavy loaded waggons or other carriages. It is observed, that near Colebrook Dale there is one at a small distance from the iron bridge, upon which loaded boats are drawn up to a canal, two hundred and twenty feet above the level of the river Severn, and let down in a similar manner into it, by which means twenty-two locks are saved, and the work executed in an expeditious manner. It is supposed, that this is the greatest inclined plane in Europe, or perhaps in the world, for though they are much used in China in the place of locks, he has never heard of any of them being equal in height to this. The rails are best made of iron. It is added, that they have been found useful in improving soft, mossy, boggy lands, on which horses cannot travel; a rail road of this sort having been formed through a peat moss near Manchester by Mr. Wakefield, while it was under improvement, at the expence only of about three hundred pounds a mile, on which a single horse was capable of drawing with the greatest facility seven waggons at once, each being loaded with about seven hundred weight of marle, bearing in the whole forty-nine hundred weight, and with the weight of the waggons upwards of three tons. This was performed, it is observed, over a place where a few months before a dog could hardly venture without the danger of being *swamped*. On the Ketley and other canals in the county of Shropshire, vast advantages have been derived from laying railways upon inclined planes, and letting down and drawing up the different articles by means of machinery, as may be seen in the very able Agricultural Report of that district, where excellent representations of them are given.

Besides these different cases of railways, another has been suggested by the writer of the Annals of Agriculture, which is that of having them laid from the stack-yards to the thrashing machines, by which the grain may be conveyed to them at any time with ease and convenience, as well as any particular stack that may be wanted.

It is further stated by the ingenious Dr. Anderson, that the best idea he can give of the benefit that may result to the community from the use of this kind of railways, will be from stating some facts respecting them, which were lately communicated to the Society of Arts by Mr. Wilkes, of Measham, near Loughborough, in Leicestershire; a spirited and judicious agriculturist. He had a railway of this sort made, which was about five miles in extent, leading from a coal-mine to a market. He found it so fully to answer his expectations after it was finished, that he communicated to the above society an account of some trials he had made of it, requesting that such of the members of that respectable institution as were desirous of information on that head, would do him the honour to witness some experiments that he wished to make upon it, for the information of the public. A committee of the members was accordingly deputed for that purpose, and before them he shewed that a moderate sized horse, of about twenty pounds value, could draw upon it with ease down hill (the descent being one foot in a hundred) thirty-two tons, and without much difficulty forty-three, and seven tons up hill, independent of the carriages. The doctor concludes from these facts, that upon a perfect level a horse could draw with ease from ten to twenty tons. It is observed, that Mr. Wilkes's railway, on which the experiments were made, was, from local circumstances, laid upon wooden sleepers, and is not so perfect as those done upon stone. But it is added, that twenty tons are the load which such a horse could draw with ease, travelling at the usual waggon rate, in boats upon a canal; so that the number of horses required in this way will not be much, if at all, greater than on a canal. Certain advantages attach to this mode of conveyance, which do not so well apply to a canal, and *vice versa*; but it is not his intention to draw a parallel between these two modes of conveyance. Nobody can entertain any doubt, he thinks, about the utility of canals where they are easily practicable. He only wishes to point out this as an eligible mode of conveyance where canals cannot be conveniently adopted.

It is further remarked, that it was customary at the first, to put the whole load to be drawn by one horse upon railways into one waggon; but now, when the load is so much augmented, it has been found eligible to divide it into many parts, so that no one waggon shall carry more than one or two tons; by this method the weight is so divided, that the pressure is never so great upon one point as to be in danger of too much crushing the road; the carriages can be made much more limber and light in all their parts, and they are much more easily moved, and more manageable in all respects than they otherwise would have been. And another advantage of this arrangement, which deserves to be particularly adverted to, is, that it admits of shifting the carriages so as to leave a load, as it were, in parcels at different places where they may be required, without trouble or expence. This, when it comes to be fully understood and carried into practice, will, he thinks, be a convenience of inestimable value, a thing that has been always wanted, and never yet has been found though it has been diligently sought for. The able writer has here endeavoured to illustrate its importance and utility in transporting goods from the wet docks now forming on the Isle of Dogs to London, and in carrying roads to different distant parts of the country; in which cases,

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cafes, and in all where there is much business to be done, they would require to be double, one for going, and the other for coming upon, to prevent interruption and interference.

And he afterwards offers a few remarks, tending to shew the practicability of the measure, and to guard against letting out upon a bad plan, which might, he supposes, in time to come, frustrate the good that might have resulted from the undertaking; merely premising, that he proposes these railways solely for the purpose of conveying weighty loads, leaving the roads, as at present, open for coaches and light carriages.

Also with a view to discover how far it may be practicable to introduce these iron railways into general use, he has made some inquiries respecting the expence of making them; and although this must vary according to the abundance and goodness of materials, and other circumstances, the following statement may serve to give some general notions on that head. In the most eligible situation, where materials are abundant and good, and circumstances favourable, the lowest expence at which a *single* railway of this sort can be made, will be about one thousand pounds a mile. But as a single railway must be liable to great inconveniences, unless under very particular circumstances, double railways ought to be considered as the only useful sort. These, for public purposes, according to the opinion of the inventor, should be very substantially made. The metal used should be of the stoutest sort, and of substance enough, not merely to carry the weights proposed, but to be equal to bear almost any blow or shock that they may be likely to experience; and, thus made, what they will lose by rust or wear, will be long ere it materially weakens them. Made after such a manner, in favourable situations in the country, a double railway may, he thinks, cost about two thousand pounds a mile, but in the neighbourhood of London, where the charge of every thing is high, and where they should be of the strongest sort, we should suppose they might cost nearly three thousand pounds a mile. It is bad economy, he thinks, to save on articles of this sort at the first; for the little expence thus laid out then will save much in repairs: how small these repairs are, may be imagined from this circumstance, that when a road is thus made, the undertaker does not scruple to supply all that are broken, free of charge, for the first three years. Say then that such a road cost three thousand pounds a mile, this would bring a charge upon the turnpike of 150*l.* a-year; say 50*l.* more for annual repairs; this is, in all, 200*l.* *per annum*. Compare this with the expence of keeping the present roads in repair. It has been suggested to him, that there is annually laid out in repairs upon the road from Hyde Park Corner to Hounslow, considerably above one thousand pounds a mile; so that the difference of expence is, even at the beginning, very much in favour of railways: and were the money thus at first expended to be gradually paid off, the tolls might thus be lowered almost to nothing. And, he thinks, that a turnpike road cannot be made in almost any situation for less, as he is told, than 1000*l.* *per mile*; but where it is of considerable width, as near great towns, it will run from 1500*l.* to 2000*l.* *per mile*; and in annual repairs, including the purchase price of materials, carting them on the road, spreading, raking off, and carting away again, from 100*l.* to 1000*l.* a mile. Say 1500*l.* prime cost, the interest is 75*l.* and 150*l.* for repairs, the annual charge of such road will be 225*l.* This is an expence of 100*l.* a-year more than the other. But for the present, let us suppose that they will be equal, the extra charge for purchasing ground for a new waggonway, &c. being equal to that surplus; let us now see what

would be the difference of charge to the employers of these waggons in the two cases. Supposing the road to be so much employed as that 100 waggons (or loaded carriages to the same amount) pass each day, carrying six tons each, drawn by eight horses; these, at one shilling each waggon for toll (or two-pence a ton), would produce 5*l.* a day, or 1825*l.* a-year; which, at the rate of eight miles for each turnpike, would be 228*l.* *per mile*, the surplus being produced by road horses and light carriages. The charge then to the employer, for this stage, must be 1825*l.* and the keep of 800 horses, besides servants, incidental charges, and owner's profits for the transporting of 600 tons of goods a day. Say that the same horses travel two stages a day, the turnpike money would be doubled; that is, 3650*l.* *per annum*; the keep of 800 horses, at 2*s.* each *per diem*, is 29,200*l.* These sums added make 32,850*l.*; owner's profit and incidental charges, say 10 *per cent.*, 3285*l.*; in all 36,135*l.*, or, on 210,000 tons (being 600 tons a day), about one-fourth *per ton*. And supposing the same quantity of goods carried on the railway, and the same turnpike money paid, and that each horse drew only fifteen tons, this would require only, he thinks, forty horses; the keep of which, at 2*s.* a day, would be 1460*l.*, add the toll, 1825*l.* is 3285*l.* *per annum*. Owner's profit, &c. upon this sum 10 *per cent.* as above, 328*l.*; in all 3613*l.*, or about four-pence a ton, just one-tenth part of the charge in the other case. He thinks, that when the object comes to be considered in this point of view, few measures that can be proposed will hold forth such an important national improvement as this would be. Considered with regard to the consumption of the produce of the earth (an object at present deserving the fullest attention, as this improvement can be applied to almost every part of the country), it would, he supposes, reduce the number of heavy road horses to one-eighth part of what they are at present, and of course augment the number of cattle or other consumable provisions in a proportionate degree, so as greatly to lower the price of the necessaries of life. It would, in the next place, lower the price of the carriage of goods of all kinds to an amazing extent; and lastly, as a consequence of that, it would give such encouragement to agriculture, as no other measure that can be contrived could ever effect, and that without costing one shilling expence to any one individual, or to the state. On the contrary, by inducing cheapness of provision, and affording such efficacious encouragement to manufactures and to agriculture, it would produce a general prosperity, which, by augmenting the consumption of taxable commodities, would augment the public revenue; while, at the same time, every individual would feel himself relieved from the pressure of many taxes that prove distressful to him at present. After justly reprobating every sort of gambling speculations by monied men in undertakings of this nature, and shewing the numerous evils that attend them, he advises it, as highly necessary to prevent these railways from ever becoming private property, on any account, to keep them open and patent alike, to all who shall choose to employ them as a king's highway, under such regulations as it shall be found necessary to subject them to by law. In short, they should, he thinks, be put upon the same footing, in all respects, as public roads are at present, only under the direction of a distinct set of commissioners, who should have the superintendence of every thing that concerns this species of roads only. These commissioners should be vested with authority under an act of parliament, to erect turnpikes upon them, to levy certain stipulated tolls, and to mortgage the produce of these tolls for the purpose of raising money to be applied in the necessary purchases of land, and making the roads. In the act it should

should be expressly stipulated, that the produce of these tolls should be applied solely to keeping the road in repair, paying the interest of sums borrowed, and clearing off the principal as fast as the collections would admit; and when the whole money borrowed was thus paid off, the tolls should be so lowered as only to produce money sufficient to keep the roads in a state of continually good repair. Thus would the expence of transporting goods be annually diminishing, and the prosperity of the country be thereby augmenting from day to day. He adds, that he is particularly earnest in this business, as he has not been an unconcerned observer of the effects that have resulted from the establishment of turnpike roads in Scotland, which were begun within his recollection; and these effects have been such as no man who had not seen it would have believed could ever have taken place. Distance may be said to be thus diminished from place to place; lands that were originally far beyond the influence of the town as a market for any thing else than live-stock, are thus brought, as it were, close to its gates; and the value of the produce of many articles is thus to them augmented fourfold, while they are at the same time diminished to the public. Not only is the value of produce raised, but the quantity also of that produce is augmented exceedingly by means of manures which become then accessible. Fossile manures, such as chalk, lime, and marle, which were formerly confined to a narrow spot, expand themselves as if it were by a magical power, and by that expandible influence diffuse around fertility, riches, and plenty. Coals and other weighty articles that may be useful in arts or manufactures of various kinds, which never were, nor ever could have been of any value to the owners of them, so long as the expence of transportation exceeded a certain sum, find a ready market to any extent as soon as the price falls below that rate, thus contributing not only towards the enriching of the owners, but to the furnishing of employment to the various persons who must be engaged in preparing or transporting them to market, and the universal accommodation of the whole. Around every market you may suppose a number of concentric circles drawn, within each of which certain articles become marketable which were not so before, and thus become the source of wealth and prosperity to many individuals. Diminish the expence of carriage but one farthing, and you widen the circle; you form, as it were, a new creation, not only of stones, and earth, and trees, and plants, but of men also, and what is more, of industry, of happiness, and joy. It is added, that by making these roads the property of the public, and free to every person to bring his own waggons upon them wherever he pleased, farmers, when near them, would make bye roads of the same sort leading into these from their respective premises; the inhabitants of villages and country districts would join together, and at one common expence make roads of the same sort leading to a greater distance inwards, as they now make bye roads for themselves. Thus would all be accommodated; those who had business enough to furnish a sufficient load for one horse might go to market with it when they pleased: those who had dealings on a smaller scale could have one, two, or more waggons of their own conjoined with those of others to make up a load for one horse: and those of still smaller means could have one waggon loaded with the joint articles belonging to two, three, or more. A ton weight might then be pushed before a man to market for many miles, as a wheelbarrow is now. It is scarcely possible, he supposes, to contemplate an institution from which would result a greater quantum of harmony, peace, and comfort, to persons living in the country, than would naturally result from this arrangement. In fact, he knows, he says, no one

measure, that would tend so effectually to lower the price of the necessaries of life, and restore abundance.

In what regards the method of forming and constructing these railways, it is observed by the same writer, that the following has been given by the inventor as the most improved plan: first, that the best line the country affords should be traced out, having regard to the direction of the carriage of articles or trade to be expected; and if such trade be both ways in nearly equal quantities, a line as nearly horizontally level as possible should be chosen. If the trade is all in one direction, as is generally the case between mines and navigation, then the most desirable line is one with a gentle gradual descent, such as shall make it not greater labour for the horses employed to draw the loaded waggons down, than the empty ones back; and this will be found to be the case on a railway descending about one foot vertical in one hundred feet horizontal. Or, if the railway and carriages are of the very best construction, the descent vertical may be to the length horizontal as 1 to 50, where there is little or no upgate loading. In cases between mines and navigations the descents will often be found greater than could be wished. On a railway on the improved plan, where the descent is more than as 1 to 50, six or eight waggons, loaded with thirty or forty hundred weight each, will have such a tendency to run downwards, as would require great labour of one horse to check and regulate, unless that tendency was checked by sledging some of the wheels. On such, and steeper roads, iron flippers are applied, one or more to a gang of waggons, as occasion may require. Each flipper being chained to the side of one of the waggons, and, being put under the wheel, forms a sledge. Where the descent is very great, steep inclined planes, with machinery, may, it is observed, be adopted, so as to render the other parts of the railway easy. On such inclined planes the descending loaded waggons being applied to raise the ascending empty, or partly loaded ones, the necessity of sledging the wheels is avoided; and the labour of the horse greatly reduced and lessened.

In order to obtain the desired levels, gentle descents, or steep inclined planes, and to avoid sharp turns, and circuitous tracks, it will often be found prudent to cross valleys by bridges and embankments; to cut through ridges of land; and in very rugged countries short tunnels may, he thinks, sometimes be necessary. The line of railway being fixed, and the plans and sections by which the same is to be executed and settled, the ground for the whole must be formed and effectually drained. The breadth of the bed for a single railway, should be, in general, four yards; and for a double one six yards, exclusive of the fences, side drains, and ramparts.

That the bed of road being so formed to the proper inclination, and the embankments and works thereof made firm, the surface must be covered with a bed of stones broken small, or good gravel, six inches in thickness or depth. On this bed must be laid the sleepers, or blocks to fasten the rails upon. These should be of stone in all places where it can be obtained in blocks of sufficient size. They should be not less than eight, nor more than twelve inches in thickness; and of such breadth (circular, square, or triangular,) as shall make them 150lbs. or 200lbs. weight each. Their shape is not material, so as they have a flat bottom to rest upon, and a small portion of their upper surface level, to form a firm bed for the end of the rails. In the centre of each block should be drilled a hole, an inch and a half diameter, and six inches in depth, to receive an octagonal plug of dry oak, five inches in length; for it should not reach the bottom of the hole; nor should it be larger than so as to put in easily,

easily, and without much driving; for if too tight fitted it might when wet burst the stone. These plugs are each to receive an iron spike or large nail, with a flat point and long head, adapted to fit the counter-sunk notches in the ends of two rails, and thereby to fasten them down in the proper position, or situation in which they are to lie.

With regard to the rails, they should be of the stoutest cast-iron, one yard in length each, formed with a flange on the inner edge, about two inches and a half high at the ends, and three and a half in the centre; and shaped in the best manner to give strength to the rails, and keep the wheels in their track. The soles of the rails, for general purposes, should not, he thinks, be less than four inches broad; and the thickness proportioned to the work they are intended for. On railways for heavy burdens, great use, and long duration, the rails should be very stout, weighing 40lbs., or, in some cases, nearly half an hundred weight each. For railways of less consequence, less weight of metal will do; but it will not be prudent to use them of less than 30lbs. weight each, in any situation exposed to breakage above ground. But it is observed that in mines, and other works under ground, where very small carriages only can be employed, very light rails are used, forming what are called train roads, on a system introduced by Mr. Carr; and these kinds of light railways have been much used above ground in Shropshire, and other counties where coals and other minerals are obtained.

It is added, that in fixing the blocks and rails great attention is required to make them firm. No earth or soft materials should be used between the blocks and the bed of small stones or gravel, on which the rails must all be fixed by an iron gage, to keep the sides at a regular distance, or parallel to each other. The best width of road for general purposes is four feet two inches between the flanges of the rails; the wheels of the carriages running in tracks about four feet six inches asunder. Rails of particular forms are necessary where roads branch out from or intersect each other; and where carriage roads cross the railways; and, at turnings of the railways, great care is required to make them perfectly easy. The rails of the side forming the inner part of the curve should be fixed a little lower than the other; and the rails should be set a little under the gage, so as to bring the sides nearer together than in the straight parts: these deviations in level and width to be in proportion to the sharpness of the curve. The blocks and rails being fixed and spiked fast, nothing more remains to be done than to fill the horse-path, or space between the blocks, with good gravel, or other proper materials; a little of which must also be put on the outside of the blocks to keep them in their proper places. This gravel should always be kept below the surface of the rails on which the wheels are to run, to keep the tracks of the wheels free from dirt and obstructions. The form of the rails must be such as will free them from dirt if the gravelling is kept below their level.

And in the constructing of the carriages great attention to avoid friction is necessary, particularly in the formation of the wheels and axles, which must be adapted to the sort of railways and kind of loading; but for which general directions cannot be given in a narrow compass. It is probable that this valuable invention may also be applicable to many other purposes in agriculture or manufactures, as it becomes more fully understood, and the facilities which it affords are better known. See CANAL.

RAIMALPOUR, in *Geography*, a town of Hindoostan, in Visiapour; 15 miles E. of Sattara.

RAIMONDI, IGNATIUS, in *Biography*. This worthy musical professor, whose performance, character, and private

virtues, are well known to our country, after a residence in it of more than thirty years, is honourably mentioned by Ernst Ludwig Gerber, the continuator of Walther's Musical Lexicon, in 2 vols. 8vo., 1792. He says, that this expressive and pleasing performer on the violin, and agreeable composer for his instrument, was born in Italy, a scholar of Barbella, settled at Amsterdam in 1772, where he remained the principal violin during twelve years, having succeeded the famous Locatelli. He had published nine different works for violins at Berlin and Amsterdam, before the year 1785. About the year 1773 he arrived in London, since which time he has published many pleasing compositions, particularly his "Battaglia," which is the best imitative instrumental music of that kind that has come to our knowledge.

RAIMPOUR, in *Geography*, a town of Hindoostan, in Rohilcund; 30 miles S. of Bareilly.

RAIN, a town of Hindoostan, in Guzerat, on the gulf of Cutch; 45 miles W. of Noanagur.—Also, a town of Bavaria; 16 miles N. of Augsburg. N. lat. 48° 37'. E. long. 10° 52'.

RAIN, or *Old Rain*, a town of Scotland, in Aberdeenshire, near which are the remains of a palace of the former bishops of Aberdeen; eight miles S.E. of Inverary.

RAIN, the distillation of water which descends from the atmosphere in drops of various sizes. By this circumstance rain is distinguished from dew or fog; in the former of which the drops are so small, that they are quite invisible; and in the latter, though they are of a larger size, they seem to have little more specific gravity than the atmosphere itself, and may therefore be reckoned hollow spherules rather than drops.

Rain is, apparently, a precipitated cloud; as clouds are nothing but vapours raised from moisture, waters, &c.

And vapours are demonstratively nothing else but little bubbles or vesiculæ detached from the surface of the teraqueous globe by the power of the solar or subterraneous heat, or some other cause. These vesiculæ, being specifically lighter than the atmosphere, are buoyed up by it, until they arrive at a region where the air is in a just balance with them; and here they float, till by some new agent they are converted into clouds, and thence either into rain, snow, hail, mist, or the like.

But the agent in this formation of the clouds into rain, and the vapours into clouds, has been much controverted. Some philosophers have supposed that the cold, which constantly occupies the superior regions of the air, chills and condenses the vesiculæ, at their arrival from a warmer quarter; congregates them together, and occasions several of them to coalesce into little masses: and by these means their quantity of matter increasing in a greater proportion than their surface, they become an overbalance to the thin air, and accordingly descend in rain.

Dr. Derham accounts for the precipitation thus; that the vesiculæ being full of air, when they meet with a colder air than that they contain, this internal air is contracted into a less space; and consequently the watery shell, or case, is rendered thicker, so as to become heavier than the air, &c.

It has, however, been objected to this hypothesis, that rain often happens in very warm weather; and though it be allowed, that the condensation may be owing to the cold of the upper regions, yet the drops acquire a considerable increase of size as they descend. E. G. On the summit of a hill they are small and occasion only a drizzling shower; but in descending the hill it becomes more considerable, and at the bottom of the hill the drops are much larger, and the

the rain is impetuous. Hence it appears that the vapours are condensed when the atmosphere is warm as well as when it is cold.

Others only allow the cold a part in the action, and ascribe a share of it to the winds, alleging, that a wind blowing against a cloud will drive its vesiculæ upon one another, by which means several of them, coalescing as before, will be enabled to descend; and the effect will be still more considerable, if two opposite winds blow together toward the same place. To which they add, that clouds already formed, happening to be augmented by fresh accessions of vapour, continually ascending, may on this account be enabled to descend.

Against the above stated hypothesis of Derham, it has been objected that the vesiculæ of vapour, if they be such, are filled, not with air, but fire or heat in a latent state, and till they part with this heat, the vapour cannot be condensed. Cold is not always sufficient to produce this effect, for in the most severe frosts the air is serene, and parts with little or none of its vapours, for a considerable time. It is also alleged, that the winds have no considerable agency, since blowing upon vapour is so far from condensing it, that it unites more closely with the air; and wind is known very much to promote evaporation. See VAPOUR.

Yet the grand cause, according to Rohault, still remains: that author conceives it to be the heat of the air, which after continuing for some time near the earth, is at length carried up on high by a wind, and there thawing the snowy villi, or flocks of the half-frozen vesiculæ, reduces them into drops; which coalescing, descend, and have their dissolution perfected in their progress through the lower and warmer stages of the atmosphere. Others, as Dr. Clarke, &c. ascribe this descent of the clouds rather to an alteration of the atmosphere than of the vesiculæ; and suppose it to arise from a diminution of the spring, or elastic force of the air.

This elasticity, which, as they say, depends chiefly or wholly on the dry terrene exhalations, being weakened, the atmosphere sinks under its burden, and the clouds fall, on the common principle of precipitation.

Now, the little vesiculæ, by any or all these means, being once upon the descent, will persist therein, notwithstanding the increase of resistance they every moment meet with in their progress through still denser and denser parts of the atmosphere. For, as they all tend toward the same point, *viz.* the centre of the earth, the farther they fall, the more coalitions will they make; and the more coalitions, the more matter will there be under the same surface; the surface only increasing as the squares; but the solidity as the cubes; and the more matter under the same surface, the less friction or resistance there will be to the same matter.

Thus if the cold, the wind, &c. happen to act early enough to precipitate the ascending vesiculæ, before they are arrived at any considerable height, the coalitions being few in so short a descent, the drops will be proportionably small: and thus is formed what we call *dew*. See DEW.

If the vapours prove more copious, and rise a little higher, we have a *mist* or *fog*; which see respectively.

A little higher still, and they produce a small rain, &c. If they neither meet with cold, nor wind enough to condense or dissipate them, they form a heavy, thick, dark sky; which lasts sometimes several weeks. This hypothesis of the diminution of the atmosphere's elasticity, requires a more satisfactory explication of the cause of this diminution. By ascribing it to terrene exhalations, we only solve one difficulty by introducing another; for we are totally un-

acquainted with the nature and operation of these exhalations. But let the cause be what may be supposed, if it act equally, and at once, upon all the vapour in the air, all that vapour must be at once precipitated; and the consequence must be, that, instead of gentle showers continuing for a considerable time, we must have copious water-spouts, lasting only for a few minutes or seconds, which, instead of refreshing the earth, would drown and lay it waste.

Those who admit either of the above hypotheses, account for many of the phenomena of the weather; *e. gr.* why a cold is always a wet summer, and a warm a dry one; because the principle of precipitation obtains in the one case, and is wanting in the other. Why we have ordinarily most rain about the equinoxes; because the vapours arise more plentifully than ordinary in the spring, as the earth becomes loosened from the brumal constrictions; and because, as the sun recedes from us in autumn, the cold increasing, the vapours that had lingered above during the summer heats, are now dispatched down, &c. Why a settled, thick, close sky scarcely ever rains till it have been first clear; because the equally diffused vapours must first be condensed, and congregated into separate clouds, to lay the foundation of rain; by which means the rest of the face of heaven is left open, and pervious to the rays of the sun, &c.

For other phenomena of rain, as they relate to the weather-glass, see BAROMETER, and WEATHER.

It cannot be doubted, that there is a connection between the descent of the barometer and the fall of rain; but no satisfactory reason has yet been assigned for the circumstance; nor is it possible to foretell with certainty that rain will follow any changes in the height of the barometer that have been observed. The immediate dependence of rain, or of any other atmospherical phenomena, on the influence of the moon, appears to be rendered highly improbable, not only by mathematical calculations of the effects of the moon's attraction, but also by the irregularity of the observations which have been adduced in favour of a such a connection. (See *Influence of the Moon*.) But however uncertain the ultimate causes of rain may be in general, their effects in some places are sufficiently constant, to be attributed to permanent local circumstances, and in particular to the periodical recurrence of similar winds.

For a more particular account of other theories, for explaining the ascent of vapours, the formation of clouds, and the fall of rain, see VAPOUR.

Besides the causes of rain, mentioned above, Defaguliers thinks it owing to the loss of electricity in the vapours of which they were formed.

Other writers, in the progress of this part of philosophical science, have considered rain as an electrical phenomenon: or at least they have supposed, that the powers of electricity may concur with other causes in producing it. Signior Beccaria, whose observations on the general state of electricity in the atmosphere have been more extensive and accurate than those of any other person, reckons rain, hail, and snow, among the effects of a moderate electricity in the atmosphere. Clouds that bring rain, he thought, were produced in the same manner as thunder clouds, only by a moderate electricity. He describes them at large, and the resemblance which all their phenomena bear to those of thunder-clouds is very striking. He notes several circumstances attending rain without lightning, which render it probable, that it is produced by the same cause as when it is accompanied with lightning. Light has been seen among the clouds by night in rainy weather; and even by day rainy clouds are sometimes seen to have a brightness evidently independent of the sun. The uniformity with

which the clouds are spread, and with which the rain falls, he thought, were evidences of an uniform cause like that of electricity. The intensity also of electricity in his apparatus generally corresponded very nearly to the quantity of rain that fell in the same time. Sometimes all the phenomena of thunder, lightning, hail, rain, snow, and wind have been observed at one time; which shews the connection they all have with some common cause. Signior Beccaria, therefore, supposes, that, previous to rain, a quantity of electric matter escapes out of the earth, in some place where there was a redundancy of it; and in its ascent to the higher regions of the air, collects and conducts into its path a great quantity of vapours. The same cause that collects, will condense them more and more; till, in the places of the nearest intervals, they come almost into contact, so as to form small drops; which, uniting with others as they fall, come down in rain. The rain will be heavier in proportion as the elasticity is more vigorous, and the cloud approaches more nearly to a thunder-cloud. He imitated the appearance of clouds that bring rain, by insulating himself between the rubber and conductor of his electrical machine; and with one hand dropping colophonia into a spoon flattened to the conductor, and holding a burning coal, while his other hand communicated with the rubber. In these circumstances the smoke spread along his arm, and, by degrees, all over his body, till it came to the other hand that communicated with the rubber. The lower surface of this smoke was every where parallel to his clothes, and the upper surface was swelled and arched like clouds replete with thunder and rain. In this manner, he supposes, the clouds that bring rain diffuse themselves from over those parts of the earth which abound with electric fire, to those parts that are exhausted of it; and by letting fall their rain, restore the equilibrium between them. Signior Beccaria also thought, that the electricity communicated to the air, which both receives and parts with it slowly, would account for the retention of vapours in a clear sky; for small disjointed clouds, not dispersed into rain; for the smaller and lighter clouds in the higher regions of the air, which are but little affected by electricity; and also for the darker, heavy, and sluggish clouds in the lower regions, which retain more of it. He even imagined that some alteration in the weight of the air might be made by this electricity of it: the phenomena of rain, he thought, favoured the supposition, that the electric matter in the air did, in some measure, lessen its pressure: for when the electric matter is actually in the air, collecting and condensing the vapours, the barometer is lowest. When the communication is made between the earth and the clouds by the rain, the quicksilver begins to rise; the electric matter, which supported part of the pressure, being discharged. *Lettere dell'Elettricismo*. Priestley's *Hist. &c. of Electricity*, vol. i. p. 427, &c. 8vo.

Dr. James Hutton's theory of rain is stated and amply illustrated in the 1st volume of the *Edinburgh Transactions*, p. 47, &c. It is well known that atmospheric air is capable, with a certain degree of heat, of dissolving a given quantity of water. (See VAPOUR.) Dr. Hutton ascertains the ratio of the dissolving power of air, in relation to water, with different degrees of heat; and thus, by mixing a portion of transparent humid warm air with a portion of cold air, the mixture becomes opaque, and part of the water will be precipitated; or, in other words, the vapour will be condensed into rain. Hence he observes, that since the capacity of air for moisture increases faster than the temperature, there must be a deposition of moisture when two saturated portions of air at different temperatures are

mixed. Dr. Hutton supposes that heat and solution do not increase by equal increments; but that, in reality, if heat be supposed to increase by equal increments along a straight line, solution will be expressed by ordinates to a curve, whose convex side is turned towards that line. That the power of solution is not increased in the same ratio with heat is, however, hypothetical, except when we rise pretty high in the scale, when its proportional increase is somewhat doubtful; nor has our author supported it by experiment. The condensation of the breath in air is not to the purpose, unless we suppose the air to be already saturated with vapour. In any view, it can only amount to this, that to render it visible, the heat must be diminished in a greater proportion than can be compensated by the power of solution in the body of air, in which the portion expired is at first immersed. In order to explain the origin of rain from this cause, we must always suppose a constant diminution of heat to take place at the moment of the condensation of the vapour; but we actually find, that the change from a state of vapour to the fluid state is attended with heat; so that rain must at once oppose its own cause, and continued rains would be impossible without the aid of other causes. Dr. Hutton endeavours, from his own system, to explain the regular and irregular seasons of rain, with regard either to the generality of its appearance, or the regularity of its return. And to obviate the apparent exceptions of the theory, from the generality of rain, he explains the proportional quantities of rain, and adds a comparative estimate of climates, in relation to rain with the meteorological observations made in our own climate. As our limits will not allow our doing full justice to our author's reasoning, we must refer to his own paper on the subject.

Mr. Dalton, in his "*Meteorological Essays*," (Ess. vi.) expresses his approbation of Dr. Hutton's theory in general; to this purpose, he says, "the principles of none appear to me to be more plausible and consistent with facts." Dr. Hutton, as we have above shewn, considers the varieties of heat and cold, affecting the solvent power of the atmosphere, as the sole causes of rain; and Mr. Dalton observes, when we consider that evaporation and the precipitation of vapour are diametrically opposite, it is reasonable to suppose that they should be promoted by opposite causes: and as heat and dry air are favourable to evaporation, so cold, operating upon air replete with vapour, promotes its precipitation. Dr. Hutton, however, seems to consider water as chemically combined with the atmosphere, and that cold produces precipitation in a manner similar to what it does in water saturated with salt, or in other chemical processes; whereas Mr. Dalton supposes, that a portion of the vapour, considered as a distinct and peculiar fluid, is condensed into water by cold; but the effects resulting from the two theories will be the same. See METEOROLOGY, and VAPOUR.

M. de Luc, in the 2d volume of his "*Thoughts on Meteorology*," has directed particular attention to the various circumstances that attend rain. He has also examined the several hypotheses of different authors, and concludes, that they are altogether insufficient to account for the formation of it. In this inquiry the grand question under discussion is, what becomes of the water that rises in vapour into the atmosphere? or what is the state in which it subsists there, between the time of its evaporation, and its falling down in rain? If it continues in the state of watery vapour, or such as is the immediate product of evaporation, it must possess the distinctive characters essential to that fluid; it must make

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make the hygrometer move towards humidity, in proportion as the vapour is more or less abundant in the air: on a diminution of heat, the humidity, as shewn by the hygrometer, must increase; and on an increase of the heat, the humidity must diminish; and the introduction of other hygroscopic substances, drier than the air, must have the same effect as an augmentation of heat. These are the properties of vapour, on every hypothesis of evaporation; and, therefore, all the water that exists in the atmosphere, without possessing these properties, is no longer vapour, but must have changed its nature. M. de Luc shews, that the water which forms rain, though it has ever been considered and reasoned upon as producing humidity, does not possess this property, and must, therefore, have passed into another state. As he thinks that the vapour passes into an invisible state in the interval between evaporation and its falling again in rain, and that in this state it is not sensible to the hygrometer, he considers the laws of hydrology as insufficient for explaining the formation of rain; but he does not pretend to have discovered the immediate cause of the formation of clouds and rain. If it is not in the immediate product of evaporation that rain has its source; if the vapours change their nature in the atmosphere, so as no longer to be sensible to the hygrometer, or to the eye; if they do not become vapour again till clouds appear; and if, when the clouds are formed, no alteration is perceived in the quality of the air; we must acknowledge it to be very probable, that the intermediate state of vapour is no other than air, and that the clouds do not proceed from any distinct fluid contained in the atmosphere, but from a decomposition of a part of the air itself, perfectly similar to the rest. For other observations on the ascent and nature of vapour, and the subsequent formation of rain, we refer to the articles METEOROLOGY, and VAPOUR.

As to the general quantity of rain that falls, and its proportion in several places at the same time, and in the same place at several times, we have many observations, journals, &c. in the Memoirs of the French Academy, the Philof. Transf. and many other publications; from which we shall make the following extracts.

Upon measuring the rain falling yearly, its depth, at a medium, is found as in the following table.

Depth of Rain falling yearly, and its Proportion in several Places.

	Inches.
At Townley, in Lancashire, observed by Mr. Townley	42 $\frac{1}{2}$
Upminster, in Essex, by Dr. Derham	19 $\frac{1}{2}$
Zurich, in Swisserland, by Dr. Scheuchzer	32 $\frac{1}{2}$
Pisa, in Italy, by Dr. Mich. Ang. Tilli	43 $\frac{1}{4}$
Paris, in France, by M. de la Hire	19
Lisle, in Flanders, by M. de Vauban	24

At Upminster.

At Paris.

Inches.	Inches.
1700 19.03	21.37
1701 18.69	27.77
1702 20.38	17.45
1703 23.99	18.51
1704 15.80	21.20
1705 16.93	14.82

Mediums 19.14

20.19

From the Meteorological Journal of the Royal Society, kept by order of the president and council, it appears that

the whole quantity of rain at London, in each of the years specified below, was as follows: viz.

	Inches.
1774 - - - - -	26.328
1775 - - - - -	24.083
1776 - - - - -	20.354
1777 - - - - -	25.371
1778 - - - - -	20.772
1779 - - - - -	26.785
1780 - - - - -	17.313

Medium of these seven years 23.001

Proportion of the Rain of the several Seasons to one another.

1708.	Depth at Pisa.	Depth at Upminster.	Depth at Zurich.
	Inches.	Inches.	Inches.
January	6.41	2.88	1.64
February	3.28	0.46	1.65
March	2.65	2.03	1.51
April	1.25	0.96	4.69
May	3.33	2.02	1.91
June	4.90	2.32	5.91
July	0.00	1.11	3.50
August	2.27	2.94	3.15
September	7.21	1.46	3.02
October	5.33	0.23	2.44
November	0.13	0.86	0.62
December	0.00	1.07	2.62
Half Year	36.76	19.24	32.66

See Philof. Transf. abr. vol. iv. pt. ii. p. 81, &c. and also Meteorological Journal of the Royal Society, published annually in the Phil. Transf.

As rain-gages have been fixed of late years in almost every part of the kingdom, we are enabled to determine, with considerable exactness, the depth of water which the rain yields in any given place. It may be observed, however, that inland counties have less rain than maritime ones, especially those which border on the western seas. But still a greater difference seems to take place between a mountainous country, and a champaign or flat country. In the former there often falls double or triple the quantity of rain in a year that there does in the latter, and never less than an equal quantity. It is also observed, that those winds bring most rain that blow from the quarter in which is the most and nearest sea; as are west and south-west winds. The rain-gage also shews, that more rain is collected in the instrument, as it is placed nearer the ground; without any appearance of a difference, between two places, on account of their difference of level above the sea, provided that the instrument is as far from the ground at the one place, as it is at the other. These effects are noticed in the Phil. Transf. for 1769 and 1771, the former by Dr. Heberden, and the latter by Mr. Daines Barrington. Dr. Heberdeen says, "A comparison having been made between the quantity of rain which fell in two places in London, about a mile distant from one another, it was found that the rain in one of them constantly exceeded that in the other, not only every month, but almost every time that it rained. The apparatus used in each of them was very exact, and both made by the same artist; and upon examining every probable cause, this unexpected variation did not appear to be owing to

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to any mistake, but to the constant effect of some circumstance which, not being supposed to be of any moment, had never been attended to. The rain-gage in one of these places was fixed so high, as to rise above all the neighbouring chimnies; the other was considerably below them; and there appeared reason to believe, that the difference in the quantity of rain in these two places was owing to this difference in the placing of the vessel in which it was received. A funnel was, therefore, placed above the highest chimnies, and another upon the ground of the garden belonging to the same house, and there was found the same difference between these two, though placed so near one another, which had been between them, when placed at similar heights in different parts of the town. After this fact was sufficiently ascertained, it was thought proper to try whether the difference would be greater at a much greater height; and a rain-gage was therefore placed upon the square part of the roof of Westminster Abbey. Here the quantity of rain was observed for a twelvemonth, the rain being measured at the end of every month, and care being taken that none should evaporate by passing a very long tube of the funnel into a bottle through a cork, to which it was exactly fitted. The tube went down very near to the bottom of the bottle, and therefore the rain which fell into it would soon rise above the end of the tube, so that the water was no where open to the air except for the small space of the area of the tube: and by trial it was found that there was no sensible evaporation through the tube thus fitted up.

The following table shews the result of these observations.

From July the 7th, 1766, to July the 7th, 1767, there fell in a Rain-gage, fixed

1766.	Below the top of a house.	Upon the top of a house.	Upon Westminster Abbey.
From the 7th to the end of July	Inches. 3.591	Inches. 3.210	Inches. 2.311
August	0.558	0.479	} 0.508
September	0.421	0.344	
October	2.364	2.061	1.416
November	1.079	0.842	0.632
December	1.612	1.258	0.994
1767, January	2.071	1.455	1.035
February	2.864	2.494	1.335
March	1.807	1.303	0.587
April	1.437	1.213	0.994
May	2.432	1.745	1.142
June	1.997	1.426	} 1.145
July 7	0.395	0.309	
	22.628	18.139	12.099

By this table it appears, that there fell below the top of a house above a fifth part more rain than what fell in the same space above the top of the same house; and that there fell upon Westminster Abbey not much above one-half of what was found to fall in the same space below the tops of the houses. This experiment has been repeated in other cases with the same result. What may be the cause of this extraordinary difference, has not yet been discovered; but it may be useful to give notice of it, in order to prevent that error, which would frequently be committed in comparing the rain of two places without attending to this circumstance."

Such were the observations of Dr. Heberden on first announcing this circumstance, viz. of different quantities of rain falling at different heights above the ground. Two

years afterward, Daines Barrington, esq. made the following experiments and observations, to shew that this effect, with respect to different places, respected only the several heights of the instruments above the ground at those places, without regard to any real difference of level in the ground at those places.

Mr. Barrington caused two other rain-gages, exactly like those of Dr. Heberden, to be placed, the one upon mount Rennig, in Wales, and the other on the plane below, at about half a mile's distance, the perpendicular height of the mountain being 450 yards, or 1350 feet; each gage being at the same height above the surface of the ground at the two stations.

The results of the experiment are as below:

1770.	Bottom of the mountain.	Top of the mountain.
	Inches.	Inches.
From July 6 to 16 - -	0.709	0.648
July 16 to 29 - -	2.185	2.124
July 29 to Aug. 10 -	0.610	0.656
Sept. 9, both bottles had run over.		
Sept. 9 to 30 - -	3.234	2.464
Oct. 17, both bottles had run over.		
Oct. 17 to 22 - -	0.747	0.885
Oct. 22 to 29 - -	1.281	1.388
Nov. 20, both bottles were broken by the frost.	8.766	8.165

"The inference to be drawn from these experiments, Mr. Barrington observes, seems to be, that the increase of the quantity of rain depends upon its nearer approximation to the earth, and scarcely at all upon the height of places, provided the rain-gages are fixed at about the same distance from the ground.

"Possibly also a much controverted point between the inhabitants of mountains and plains may receive a solution from these experiments; as in an adjacent valley, at least, very nearly the same quantity of rain appears to fall within the same period of time as upon the neighbouring mountains."

Dr. Heberden also adds the following note. "It may not be improper to subjoin to the foregoing account, that, in places where it was first observed, a different quantity of rain would be collected, according as the rain-gages were placed above or below the tops of the neighbouring buildings; the rain-gage below the top of the house into which the greater quantity of rain had for several years been found to fall, was above fifteen feet above the level of the other rain-gage, which, in another part of London, was placed above the top of the house, and into which the lesser quantity always fell. This difference, therefore, does not, as Mr. Barrington justly remarks, depend upon the greater quantity of atmosphere through which the rain descends: though this has been supposed by some, who have thence concluded that this appearance might readily be solved by the accumulation of more drops, in a descent through a great depth of atmosphere."

In the examination of the results from meteorological tables, it should be observed, that several years' account of the rain at any place is required, before a medium yearly quantity can be obtained with sufficient accuracy. The following table, formed by Mr. Dalton, and published in the first part of the fifth volume of Manchester Memoirs, gives us the largest collection of accounts of rain fallen in different places in England that has to our knowledge hitherto appeared. They are chiefly taken from the Transactions of the Royal Society, and of other societies.

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Counties (Maritime).	Places.	Mean annual Depth in Inches.
CUMBERLAND	Keswick, 7 years	- 67.5
	Carlisle, 1 year	- 20.2
WESTMORELAND	Kendal, 11 years	- 59.8
	Fell-foot, 3 years	- 55.7
LANCASHIRE	Waith Sutton, 5 years	- 46
	Lancaster, 10 years	- 45
	Liverpool, 18 years	- 34.4
	Manchester, 9 years	- 33
	Townley	- 41
GLOUCESTERSHIRE	Crawshawbooth, near Haf- lingden, 2 years	- } 60
	Bristol, 3 years	- 29.2
SOMERSETSHIRE	Bridgewater, 3 years	- 29.3
CORNWALL	Ludgvan, near Mount's Bay, 5 years	- } 41
	Another place, 1 year	- 29.9
DEVONSHIRE	Plymouth, 2 years	- 46.5
HAMPSHIRE	Selbourne, 9 years	- 37.2
	Fyfield, 7 years	- 25.9
KENT	Dover, 5 years	- 37.5
ESSEX	Upminster	- 19.5
NORFOLK	Norwich, 13 years	- 25.5
YORKSHIRE	Barrowby, near Leeds, 6 years	- } 27.5
	Garfdale, near Sedburgh, 3 years	- } 52.3
	Widdrington, 1 year	- 21.2
NORTHUMBERLAND		
Counties (Inland).	Places.	Means.
MIDDLESEX	London, 7 years	- 23
SURREY	South Lambeth, 9 years	- 22.7
HERTFORDSHIRE	Near Ware, 5 years	- 25
HUNTINGDONSHIRE	Kimbolton, 7 years	- 25
DERBYSHIRE	Chatsworth, 15 years	- 27.8
RUTLANDSHIRE	Lyndon, 21 years	- 24.3
NORTHAMPTONSHIRE	Near Oundle, 14 years	- 23
General mean		35.2

The general mean of 35.2 inches is, as our author apprehends, a little above the medium for England and Wales, as the greater number of places are those where much rain falls. If we take up a mean for each of the above-mentioned counties, (where more than one place in a county is given,) and then a general mean from the counties, the result is a reduced mean of 31.3. Even then it may be objected, that the greater part of the counties are maritime; but it must be observed, that there is no account of rain in Wales: and we may safely conclude, that the rain in Wales would exceed the last-mentioned mean as much as the inland counties of England, not in the above list, would fall short; because Wales is both a mountainous country, and exposed to the sea.

We will, therefore, conclude, that the mean annual depth of rain in England and Wales, deduced from these twenty counties, is 31 inches: a quantity which subsequent observations, our author is confident, will not diminish, and probably not increase much.

The editors of the Encyclopedia, under the article *Weather*, from 16 places of observation, make the annual mean for Great Britain 32.53 inches; and M. Cotte, in the *Journal de Physique* for 1791, gives a mean derived from 147 places, in different parts of the world, equal to 34.7 inches.

If we take the dew (see DEW) at 5 inches annually, we

shall have 36 inches of water at a medium annually, on the surface of the earth, in England and Wales, reckoning 31 for rain and 5 for dew. Admitting the computation of Guthrie, the area of England and Wales is 46,450 square miles. This, reduced to square feet, gives 1,378,586,880,000; which, multiplied by 3 feet, the annual depth of rain and dew, gives 4,135,760,690,000 cubic feet of water, = 153,176,320,000 cubic yards, or 28 cubic miles = 115 thousand millions of tons in weight, nearly. This immense mass of water is disposed of partly by the supply of rivulets, and the soaking into the earth a small way, so as to break out again in lower ground in the form of springs, and thence make its way to some river, by which it is conveyed to the sea; and partly by being raised into the atmosphere in the process of evaporation. The decomposition of water by vegetables is not noticed, because it is presumed, that in the course of nature the principles are combined, and water formed again. See RIVER, SPRING, EVAPORATION, and VAPOUR.

As to the use of rain, we may observe that it moistens and softens the earth, and thus fits it for affording nourishment to plants: by falling on high mountains, it carries down with it many particles of loose earth, which serve to fertilize the surrounding vallies, and purifies the air from noxious exhalations, which tend in their return to the earth to meliorate the soil; it moderates the heat of the air; and is one means of supplying fountains and rivers. However, vehement rains in many countries are found to be attended with barrenness and poorness of the lands, and miscarriage of the crops in the succeeding year: and the reason is plain; for these excessive storms wash away the fine mould into the rivers, which carry it into the sea, and it is a long time before the land recovers itself again. The remedy to the famine, which some countries are subject to from this sort of mischief, is the planting large orchards and groves of such trees as bear esculent fruit; for it is an old observation, that in years, when grain succeeds worst, these trees produce most fruit of all. It may partly be owing to the thorough moistening of the earth, as deep as their roots go, by these rains, and partly to their trunks stopping part of the light mould carried down by the rains, and by this means furnishing themselves with a coat of new earth. Phil. Transf. N° 90.

The water afforded by rain is found highly refreshing to almost all sorts of vegetable crops, and to promote their growth in a rapid manner, when not produced in too great abundance at a time. This effect, which may often be perceived to take place in a sudden manner, after warm showers in the early spring months, is probably caused by the large proportion of oxygen that is contained in rain-water, as well as from the necessary moisture being afforded to the fibres of the roots of the plants. Too much rain may be injurious, however, by lessening the necessary cohesion and compactness of soils, by which they may not afford proper firmness to the roots of growing vegetables. And another injury may be produced by the too frequent occurrence of hasty showers, by which a large proportion of the decomposing vegetable and animal materials of lands, which are soluble or diffusible in water, may be conveyed away into the ditches, rivers, and ultimately into the sea, and of course prove the cause of infertility. In hilly situations, this effect may arise from even slight showers; on which account, they have been advised to be ploughed in a slanting direction, as by that means the rains may be more perfectly detained in the soils. And it has been suggested by Dr. Darwin, that as the foliage or buds of plants require more moisture for their vigorous growth than their flowers, in this climate, continued rains may be liable not only to wash off the farina from

from the huriling anthers, and in that way prevent the impregnation of the pistillum, but also delay the ripening of the seeds or fruit, from the want of a due evaporation of their perspirable matter, as well as from the less solar light in cloudy seasons. On this account it is, he supposes, that in the north of Scotland the oats are said seldom to ripen till the frost commences, with the dry season which accompanies it.

Thus, as the effects of rain are so very considerable on vegetation, it would be highly useful to ascertain the quantity or depth of rain that falls annually in different districts, and the difference in the effects which are produced by it. See WATER and WEATHER.

The vast quantities of rain which fall in some districts, from the peculiar nature of their situations, especially where they are of the grazing or pasture kind, as those of Cheshire, Lancashire, and some others, are often highly beneficial to their general fertility; the natural grass pastures of which districts, though frequently of inferior qualities to those in many other places, are, in consequence of this circumstance, rendered superior in their abundance of grass, the strength of its vegetation, and the richness of its quality. The former of the above counties may indeed, without any impropriety, be reckoned one of the most productive grass-land districts in the kingdom, as is fully evinced by the great abundance and superiority of its dairy products. The grass lands in this tract of country mostly retain their full verdure during the most sultry and parching seasons, except where they are of a sandy or gravelly nature in their under strata. Where they are near to the sea, however, in this as well as other parts, they are liable to become mossy, or be covered with the moss plant, either in consequence of so much of the spray from it falling in the manner of slight rain, or some other cause of that kind.

The quantity of rain falling upon land has much influence upon its temperature, or state of heat, and, of course, great effect on vegetation in that way; and the nature of its mixture with it, or the manner in which it is distributed through its parts, or combined with its different earthy materials, is another means by which it becomes of great importance, as it relates to the supplying of nourishment and support to vegetables as crops.

Rain falling in large quantities, on particular sorts of retentive soils, is a frequent cause of that kind of injurious wetness, which stands so much in need of surface-draining to remove it. See SURFACE-Draining.

The nature and causes of showers and rain are extremely curious and interesting in several different points of view, both to the agriculturist and the philosophical inquirer.

RAINS, Preternatural. We have numerous accounts in historians of preternatural rains, such as the raining of stones, of dust, of blood, nay, and of living animals, as young frogs, and the like. We are not to doubt the truth of what those who are authors of veracity and credit relate to us of this kind, so far as to suppose that the FALLING of Stones (which see) and dust never happened; the whole mistake (if it be so with regard to the first instance) is the supposing them to have fallen from the clouds; but as to the blood and frogs, it is very certain that they never fall at all, but the opinion has been a mere deception of the eyes. Men are extremely fond of the marvellous in their relations; but the judicious reader is to examine strictly whatever is reported of this kind, and is not to suffer himself to be deceived.

There are two natural methods by which quantities of stones and dust may fall in certain places, without their having been generated in the clouds, or fallen as rain. The one is by means of hurricanes: the wind which we fre-

quently see tearing off the tiles of houses, and carrying them to considerable distances, being equally able to take up a quantity of stones, and drop them again at some other place. But the other, which is much the most powerful, and probably the most usual way, is for the eruptions of volcanos, and burning mountains, to toss up, as they frequently do, a vast quantity of stones, ashes, and cinders, to an immense height in the air; and these being hurried away by the hurricanes and impetuous winds, which usually accompany those eruptions, and being in themselves much lighter than common stones, as being half calcined, may easily be thus carried to vast distances, and their falling in places where the inhabitants know nothing of the occasion, they cannot but be supposed by the vulgar to fall on them from the clouds. It is well known, that in the great eruptions of *Ætna* and *Vesuvius*, showers of ashes, dust, and small cinders, have been seen to obscure the air, and overspread the surface of the sea for a great way, and cover the decks of ships; and this at such a distance, as it should appear scarce conceivable that they should have been carried to; and probably, if the accounts of all the showers of these substances mentioned by authors be collected, they will all be found to have fallen within such distances of volcanos; and if compared, as to the time of their falling, will be found to correspond in that also with the eruptions of those mountains. We have known instances of the ashes from *Vesuvius* having been carried thirty, nay forty leagues, and peculiar accidents may have carried them yet farther.

The raining of blood has been ever accounted a more terrible sight, and a more fatal omen, than the other preternatural rains already mentioned. It is very certain that nature forms blood no where but in the vessels of animals, and therefore showers of it from the clouds are by no means to be credited. Those who suppose that what has been taken for blood, has been actually seen falling through the air, have had recourse to flying insects for its origin, and suppose it the eggs or dung of certain butterflies discharged from them as they were high up in the air. But this seems a very wild conjecture, as we know of no butterfly whose excrements, or eggs, are of such a colour, or whose abode is so high, or their flocks so numerous, as to be the occasion of this.

It is most probable that these bloody waters were never seen falling, but the people seeing the standing waters blood-coloured, were assured, from their not knowing how it should else happen, that it had rained blood into them. A very memorable instance of this there was at the Hague in the year 1670. Swammerdam, who relates it, tells us, that one morning the whole town was in an uproar, on finding their lakes and ditches full of blood, as they thought, and having been certainly full of water the night before, they agreed it must have rained blood in the night; but a certain physician went down to one of the canals, and taking home a quantity of this blood-coloured water, he examined it by the microscope, and found that the water was water still, and had not at all changed its colour, but that it was full of prodigious swarms of small red animals, all alive, and very nimble in their motions, whose colour and prodigious number gave a red tinge to the whole body of the water they lived in, on a less accurate inspection. The certainty that this was the case, did not however persuade the Hollanders to part with the miracle; they prudently concluded, that the sudden appearance of such a number of animals was as great a prodigy as the raining of blood would have been; and are assured at this day, that this portent foretold the scene of war and devastation which *Lewis XIV.* afterwards brought into that country, which had before enjoyed forty years uninterrupted peace.

The animals, which thus colour the water of lakes and ponds, are the *pulices arborescentes* of Swammerdam, or the water-fleas with branched horns. These creatures are of a reddish-yellow, or flame colour; they live about the sides of ditches, under weeds, and among the mud, and are therefore the less visible, except at a certain time, which is in the end of May or beginning of June: it is at this time that these little animals leave their recesses to float loose about the water, to meet for the propagation of their species, and by that means become visible in the colour they give the water. This is visible, more or less, in one part or other of almost all standing waters at this season; and it is always at this season that the bloody waters have alarmed the ignorant.

The raining of frogs is a thing not less wonderful in the accounts of authors who love the marvellous, than those of blood, or of stones; and this is supposed to happen so often, that there are multitudes who pretend to have been eye-witnesses of it. These rains of frogs always happen after very dry seasons, and are much more frequent in the hotter countries than the cold ones. In Italy they are very frequent; and it is not uncommon to see the streets of Rome swarming both with young frogs and toads in an instant, in a shower of rain; they hopping every where between the people's legs, as they walk, though there was not the least appearance of them before. Nay, they have been seen to fall through the air down upon the pavements. This seems a strong circumstance in favour of their being rained down from the clouds, but when strictly examined, it comes to nothing; for these frogs, that are seen to fall, are always found dead, lamed, or bruised by the fall, and never hop about as the rest; and they are never seen to fall, except close under the walls of houses, from the roofs and gutters of which they have accidentally slipped down.

To the raining of frogs we ought to add the raining of grass-hoppers and locusts, which have sometimes appeared in prodigious numbers, and devoured the fruits of the earth. There has not been the least pretence for supposing that these animals descended from the clouds, but that they appeared on a sudden in prodigious numbers. The naturalist, who knows the many accidents attending the eggs of these, and other the like animals, cannot but know that some seasons will prove particularly favourable to the hatching of them, and the prodigious number of eggs that many insects lay, could not but every year bring us such abundance of the young, were they not liable to many accidents, and had not provident nature taken care, as in many plants, to continue the species by a very numerous stock of seeds, of which perhaps not one in five hundred need take root, in order to continue an equal number of plants.

The raining of fishes has been a prodigy also much talked of in France, where the streets of a town at some distance from Paris, after a terrible hurricane in the night, which tore up trees, blew down houses, &c. were found in a manner covered with fishes of various sizes. Nobody here made any doubt of these having fallen from the clouds; nor did the absurdity of fish, of five or six inches long, being generated in the air, at all startle the people, or shake their belief in the miracle, till they found upon enquiry that a very well-stocked fish-pond, which stood on an eminence in the neighbourhood, had been blown dry by the hurricane, and only the great fish left at the bottom of it, all the smaller fry having been tossed into their streets.

Upon the whole, all the supposed marvellous rains have been owing to substances naturally produced on the earth, and either never having been in the air at all, or only carried thither by accident.

RAIN, *Freezing*. See FREEZING.

RAIN-Bird, in Ornithology. See CUCULUS *Pluvialis*.

RAIN-Fowl, an English name given by many to the common green woodpecker, or *picus viridis*, from an observation that it is always most clamorous when rainy weather is coming on. The Latins have, for the same reason, called it the *pluvialis avis*. See PICUS.

RAIN-Gage, called also *Ombrometer* and *Pluviometer*, an instrument for measuring the quantity of rain that falls. That which is mentioned under the article OMBROMETER, consists of a tin funnel *d* (Plate XXIV. *Miscellany*, fig. 2.), whose surface is an inch square, a flat board *aa*, and a glass tube *bb*, set into the middle of it in a groove, and an index with divisions *c, c*; the board and tube being of any length at pleasure. The bore of the tube is about half an inch, which, says Mr. Pickering, the inventor, is the best size. This machine is fixed in some free and open place, as the top of the house, &c.

The rain-gage employed in the house of the Royal Society, is described by Mr. Cavendish in the Phil. Trans. for 1776, p. 384. The vessel which receives the rain is a conical funnel, strengthened at the top by a brass ring, twelve inches in diameter. The sides of the funnel, and inner lip of the brass ring, are inclined to the horizon, at an angle of above 65° , and the outer lip at an angle of above 50° , which are such degrees of steepness, that there seems to be no probability either that any rain which falls within the funnel, or on the inner lip of the ring, should dash out, or that any which falls on the outer lip should dash into the funnel. A vertical section of the funnel appears in Plate XXIV. *Miscellany*, fig. 3; A B C and *a b c* being the brass ring, B A and *b a* the inner lip, and B C and *b c* the outer. This vessel is placed on some flat leads, on the top of the society's house. It can hardly be screened from any rain by the chimnies, as none of them are elevated above it in an angle of more than 25° , and as it is raised $3\frac{1}{2}$ feet above the roof, there seems no danger of any rain dashing into it by rebounding from the lead.

In fixing rain-gages care should be taken that the rain may have free access to them, without being impeded or overshadowed by buildings, &c. and therefore the tops of houses are to be preferred. Also, when the quantities of rain collected in them, at different places, are compared together, the instruments ought to be fixed at the same height above the ground at both places; because at different heights the quantities are always different, even in the same place. And hence also, any register or account of rain in the gage ought to be accompanied with a note of the height at which the instrument is placed above the ground. Dalton found the rain of a gage 50 yards high, in summer two-thirds, and in winter one-half as much as that of a gage below. Mr. Dalton observes, that a strong funnel, made of sheet iron, tinned and painted, with a perpendicular rim, two or three inches high, fixed horizontally in a convenient frame, with a bottle under it to receive the rain, is sufficient for this purpose.

The rain-gage is an invention which should be in the possession of every correct farmer in every part of the kingdom, and which would thereby have much tendency to the improvement of agriculture as contributing to the knowledge of the degree of moisture which prevails in the soils, after showers or heavy rains, with greater accuracy and correctness than has been hitherto the case.

It is noticed by Mr. Naismith, in his Agricultural Survey of Clydesdale, that professor Anderson, of the university of Glasgow, has invented, perhaps, the most ingenious and accurate rain-gage of any that has yet been known. It receives the

the rain at a little more than one hundred feet above the level of the sea; accounts of which have been regularly kept since the year 1781; but previously to that period the rain was measured by an old rain-gage. It is to be regretted, however, that the exact nature of this invention is not more fully explained; and that other cheap plain inventions of this nature are not better known to the farmer.

RAIN-Water. See WATER.

RAINS, in the *Sea Language*, denote all that tract of sea to the northward of the equator, between four and ten degrees of latitude; and lying between the meridian of Cape Verde and that of the easternmost islands of the same name.

It takes its name from the almost continual calms, constant rains, and thunder and lightning, to a great degree, always found there. The winds, when they do blow, are only small uncertain gusts, and shift about all round the compass; so that ships are sometimes detained here a long while, and can make but very little way.

RAINANGBONG, in *Geography*, a town of the Birman empire, situated near a river in which there are several wells of petroleum, whence its name signifying a town through which flows a river of earth-oil. N. lat. $20^{\circ} 26'$. E. long. $94^{\circ} 46'$.

RAINBOW, *Iris*, or, simply, the *bow*, a meteor in form of a parti-coloured arch, or semicircle, exhibited in a rainy sky, opposite to the sun, by the refraction of his rays in the drops of falling rain.

There is also a secondary, or fainter bow, usually seen investing the former at some distance. Among naturalists, we also read of *lunar rainbows*, *marine rainbows*, &c.

The rainbow, sir Isaac Newton observes, never appears but where it rains in the sun shine; and it may be represented artificially by contriving water to fall in little drops, like rain, through which the sun shining, exhibits a bow to a spectator placed between the sun and the drops; especially if a dark body, *e. gr.* a black cloth, be disposed beyond the drops.

That the rainbow is opposite to the sun, has always been observed. It was, therefore, natural to imagine, that the colours of it were produced by some kind of reflection of the rays of light from drops of rain or vapour. The regular order of the clouds was another circumstance that could not have escaped the notice of any person. But though mere reflection had in no other case been observed to produce colours, and it could not but have been observed that refraction is frequently attended with that phenomenon, so that some of the ancients, as we learn from Aristotle's tract on meteors, knew that the rainbow was caused by the refraction of the sun's light in drops of falling rain; yet no person seems to have thought of having recourse to a proper refraction in this case before one Fletcher of Breslaw, who, in a treatise which he published in 1571, endeavoured to account for the colours of the rainbow by means of a double refraction, and one reflection. But he imagined that a ray of light, after entering a drop of rain, and suffering a refraction, both at its entrance and exit, was afterwards reflected from another drop, before it reached the eye of the spectator. He seems to have overlooked the reflection at the farther side of the drop, or to have imagined that all the bendings of the light within the drop would not make a sufficient curvature, to bring the ray of the sun to the eye of the spectator. Antonio de Dominis, bishop of Spalato, whose treatise, "*De Radiis Visus et Lucis*," was published by I. Bartolus, in 1611, was the first person who advanced, that the double refraction of Fletcher, with an intervening reflection, was sufficient to produce the colours of the rainbow, and also to

bring the rays that formed them to the eye of the spectator, without any subsequent reflection. He distinctly describes the progress of a ray of light entering the upper part of the drop, where it suffers one refraction, and after being thereby thrown upon the back part of the inner surface, is from thence reflected to the lower part of the drop; at which place undergoing a second refraction, it is thereby bent so as to come directly to the eye. To verify this hypothesis, he procured a small globe of solid glass, and viewing it when it was exposed to the rays of the sun, in the same manner in which he had supposed that the drops of rain were situated with respect to them, he actually observed the same colours which he had seen in the true rainbow, and in the same order. The theory of A. de Dominis was adopted, and in some degree improved, by Descartes. Philosophers were, however, for a long time at a loss when they endeavoured to assign reasons for all the particular colours, and for the order of them. Indeed, nothing but the doctrine of the different refrangibility of the rays of light, which was a discovery reserved for the great sir Isaac Newton, could furnish a complete solution of this difficulty.

Dr. Barrow, in his "*Lectiones Opticæ*," (Lect. 12. n. 14.) says, that a friend of his, meaning Mr. Newton, communicated to him a method of determining the angle of the rainbow, which was hinted to Newton by Slusius, without making a table of the refractions, as Descartes did. The doctor shews the method, with other curious particulars. But the subject was given more perfectly by Newton afterwards, in his "*Optics*," prop. 9; where he makes the breadth of the interior bow to be nearly $2^{\circ} 15'$, that of the exterior $3^{\circ} 40'$, their distance $8^{\circ} 25'$, the greatest semidiameter of the interior bow $42^{\circ} 17'$, and the least of the exterior $50^{\circ} 42'$, when their colours appear strong and perfect.

RAINBOW, *Theory of the*. To conceive the origin of the rainbow, let us consider what will befall rays of light coming from a very remote body, *e. gr.* the sun, and falling on a globe of water, such as we know a drop of rain to be.

Suppose, then, A D K N (*Plate XVIII. Optics, fig. 1.*) to be a drop of rain, and the lines E F, B A, O N, to be rays of light coming from the centre of the sun; which, on account of the immense distance of the sun, we conceive to be parallel.

Now the ray B A being the only one that falls perpendicularly on the surface of the water, and all the rest obliquely, it is easily inferred, that all the other rays will be refracted towards the perpendicular. (See REFRACTION.) Thus the ray E F, and others accompanying it, will not go on straight to G; but as they arrive at H I, they will deflect from F to K; where some of them, probably, escaping into the air, the rest are reflected upon the line K N, so as to make the angles of incidence and reflection equal.

Farther, as the ray K N, and those accompanying it, fall obliquely upon the surface of the globule, they cannot pass out into the air, without being refracted, so as to recede from the perpendicular L M; and, therefore, they will not proceed straight to Y, but will deflect to P.

It may be here observed, that some of the rays, arriving at N, do not pass out into the air, but are again reflected to Q; where being refracted, like the rest, they do not proceed right to Z; but, declining from the perpendicular T V, are carried to R; but since we here only regard the rays as they may affect the eye placed a little below the drop, *e. gr.* at P, those which deflect from N to Q, we set aside, as useless; because they never come to the eye. On the contrary, it is to be observed, that there are other rays,

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rays, as 2 3, and the like; which, being refracted from 3 to 4, and reflected to 5, and from 5 to 6, may at length, by refraction at 6, arrive at the eye γ placed beneath the drop.

Thus much is obvious; but to determine precisely the quantities of refraction of each ray, there must be a calculation; by such calculation it appears, that the rays which fall on the quadrant A D, are continued in lines, like those here drawn in the drop A D K N; wherein there are three things very considerable: first, that the two refractions of the rays, in their ingresses and egresses, are both the same way; so that the latter does not destroy the effect of the former. Secondly, that of all the rays passing out of A N, N P, and those adjoining to it, are the only ones capable of affecting the sense, as being sufficiently close and contiguous, and because they come out parallel; whereas the rest are diverging, and dispersed too far to have any sensible effect, at least to produce any thing so vivid as the colours of the bow. Thirdly, that the ray N P has shade or darkness under it; for, since there is no ray comes out of the surface N 4, it is the same thing as if the part were covered with an opaque body. We might add that the same ray N P has darkness above it; since the rays that are above it are ineffectual, and signify no more than if there were none at all.

Add to this, that all the effectual rays have the same point of reflection, *i. e.* the parallel and contiguous rays, which alone are effectual after refraction, will all meet in the same point of the circumference, and be reflected thence to the eyes.

Farther, it appears, that the angle O N P, included between the ray N P, and the line O N drawn from the centre of the sun, is the angle by which the rainbow is distant from the opposite point of the sun, and which makes the semidiameter of the bow. The method of determining it will be seen in the sequel of the article. But since, besides those rays coming from the centre of the sun to the drop of water, there are many more from the several points of its surface; there are a great many other effectual rays to be considered, especially that from the uppermost, and that from the lowest part of the sun's body.

Since, then, the apparent semidiameter of the sun is about 16 minutes, it follows, that an effectual ray from the upper part of the sun will fall higher than the ray E F by 16 minutes: thus does the ray G H (*fig. 2.*) which, being refracted as much as E F, deflects to I, thence to L, and at length emerging equally refracted with the ray N P, proceeds to M; and makes an angle O N M with the line O N. In the like manner, the effectual ray Q R coming from the lowest part of the sun, falls on the point R, 16 minutes lower than the point F on which the ray E F falls; and this, being refracted, declines to S, whence it is reflected to T; where, emerging into the air, it proceeds to V; so that the line T V, and the ray O T, contain an angle whose magnitude will be ascertained. Again, upon computing the deflections of the rays, which like that 2 3 (*fig. 1.*) coming from the centre of the sun, and being received into the lower part of the drop, we have supposed to be twice reflected, and twice refracted, and to enter the eye by lines like that 6 7 (*fig. 3.*) we find that which may be accounted effectual, as 6 7 with the line 8 6 drawn from the centre of the sun, contains an angle 8 6 7; whence it follows, that the effectual ray from the highest part of the sun, with the same line 8 6, includes an angle less by 16 minutes; and that from the lowest part of the sun, an angle greater by 16 minutes.

Thus, since A B C D E F is the path of the efficacious

ray from the highest part of the sun to the eye in F, the angle 8 6 F becomes of a certain magnitude ascertained below. In like manner, since G H I K L M is the way of an effectual ray from the lowest part of the sun to the eye, the angle 8 6 M becomes greater than the former by 16 minutes.

Since, then, we admit several rays to be effectual, besides those from the centre of the sun, what we have said of the shade will need some alteration; for of the three rays described (*figs. 2 and 3.*), only the two extreme ones will have a shadow joined to them, and that only on the outer side. Hence it is evident, that these rays are perfectly disposed to exhibit all the colours of the prism.

For the great quantity of dense or intense light, *i. e.* the bundle of rays collected together in a certain point, *v. gr.* in the point of reflection of the effectual rays, may be accounted as a lucid or radiant body, terminated all around by shade. But the several rays, thus emitted to the eye, are both of different colours; that is, they are fitted to excite in us the ideas of different colours; and are differently refracted out of the water into the air, notwithstanding their falling alike upon the refracting surface.

Hence it follows, that the different or heterogeneous rays will be separated from one another, and will tend separate ways; and the homogeneous rays will be collected, and tend the same way; and, therefore, this lucid point of the drop in which the refraction is effected, will appear fringed or bordered with several colours; that is, red, green, and blue colours will arise from the extremes of the red, green, and blue rays of the sun, transmitted to the eye from several drops, one higher than another, after the same manner as is done in viewing lucid or other bodies through a prism.

Thus, adds sir Isaac Newton, the rays that differ in refrangibility, will emerge at different angles; and, consequently, according to their different degrees of refrangibility, emerging most copiously at different angles, they will exhibit different colours in different places.

A great number, then, of these little globules being diffused in the air, will fill the whole space with these different colours; provided they be so disposed as that effectual rays may come from them to the eye; and thus will the rainbow, at length, arise.

Now, to determine what that *disposition* must be, suppose a right line drawn from the centre of the sun through the eye of the spectator, as the line V X (*fig. 2.*) called the *line of aspect*, or *axis of vision*; being drawn from so remote a point, it may be esteemed parallel to all other lines drawn from the same point; but a right line, falling on two parallels, makes the alternate angles equal.

If, then, an indefinite number of lines be imagined drawn from the spectator's eye to a part opposite to the sun where it rains; which lines make different angles with the line of aspect, equal to the angles of refraction of the differently refrangible rays, these lines, falling on drops of rain illuminated by the sun, will make angles of the same magnitude with rays drawn from the centre of the sun to the same drops. And, therefore, the lines thus drawn from the eye will represent the effectual rays that occasion the sensation of any colour.

Now it is known, that the eye, being placed in the vertex of a cone, sees objects upon its surface, as if they were in a circle; and the eye of our spectator is here in the common vertex of several cones, formed by the several kinds of efficacious rays, with the line of aspect. Now in the surface of that whole angle at the vertex, or eye, is the greatest, and in which the others are included, are those drops, or parts

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of drops, which appear red; and in the surface of that cone whose angle is least, are the purple drops; and in the intermediate cones, are the green, blue, &c. drops. Hence, then, several kinds of the drops must appear as if disposed into so many circular coloured fasciæ, or arches, as we see in the rainbow. (Rohault's System of Nat. Phil. vol. ii. part iii. cap. 17.) This part of the solution Sir Isaac Newton expresses more precisely, thus: suppose O (*fig. 4.*) the eye, and OP a line parallel to the sun's rays; and let POE, POF, be angles of $40^{\circ} 17'$, and $42^{\circ} 2'$. And suppose the angles to turn about their common side OP, with their other sides OE and OF, they will describe the bounds, or verges, of the rainbow.

For if E, F be drops placed any where in the conical surface described by OE, OF, and be illuminated by the sun's rays SE, SF; the angle SEO being equal to the angle POE, or $40^{\circ} 17'$, shall be the greatest angle in which the most refrangible rays can, after reflection, be refracted to the eye; and, therefore, all the drops in the line OE shall send the most refrangible rays most copiously to the eye, and therefore strike the senses with the deepest violet colour in that region.

And in like manner the angle SFO being = to the angle POF = $42^{\circ} 2'$, shall be the greatest in which the least refrangible rays after one reflection can emerge out of the drops; and these rays shall come most copiously to the eye from the drops in the line OF, and strike the senses with the deepest red colour in that region.

And, by the same argument, the rays which have intermediate degrees of refrangibility, shall come most copiously from drops between E and F, and so strike the senses with the intermediate colours, in the order which their degrees of refrangibility require; that is, in the progress from E to F, or from the inside of the bow to the outside, in this order; violet, indigo, blue, green, yellow, orange, red; though the violet, by the mixture of the white light of the clouds, will appear faint, and incline to a purple.

Here it may be observed, that all the rays but the violet in the line SE will emerge from E in a greater angle than SEO made by the violet, and consequently will pass below the eye; and all the rays but the red in the line SF will emerge from F in a less angle than SFO made by the red, and consequently will pass above the eye; by which means only red will appear in the line SF, and only violet in the line SE.

And, since the lines OE, OF, may be situated any where in the above-mentioned conical surface; what is said of the drops and colours of these lines, is to be understood of the drops and colours throughout the whole superficies. Thus is the *primary* or *inner bow* formed.

RAINBOW, Secondary, or Outer. As to the secondary, or fainter bow, usually surrounding the former, in assigning what drops would appear coloured, we excluded such as lines drawn from the eye, making angles a little greater than $42^{\circ} 2'$, shall fall upon, but not such as should contain angles much greater.

For, if an indefinite number of such lines be drawn from the spectator's eye, some of which make angles of $50^{\circ} 57'$, with the line of aspect, *e. gr.* OG; other angles, of $54^{\circ} 7'$, *e. gr.* OH; those drops on which these lines fall must of necessity exhibit colours; particularly those of $50^{\circ} 57'$.

E. gr. The drop G will appear red; the line GO being the same with an effectual ray; which, after two reflections, and two refractions, exhibits a red colour. Again, those drops which receive lines of $54^{\circ} 7'$, *e. gr.* the drop H, will appear purple; the line OH being the same with an effect-

tual ray; which, after two reflections and two refractions, exhibits purple.

Now there being a sufficient number of these drops, it is evident there must be a second rainbow, formed after the like manner as the first.

Thus, according to Sir Isaac Newton, in the least refrangible rays, the least angle at which a drop can send effectual rays after two reflections, is found by computation to be $50^{\circ} 57'$; and in the most refrangible, the least angle is found $54^{\circ} 7'$.

Suppose, then, O the place of the eye, as before, and POG, POH, to be angles of $50^{\circ} 57'$, and $54^{\circ} 7'$; and these angles to be turned about their common side OP; with their other sides OG, OH, they will describe the verges, or borders, of the rainbow CHDG.

For, if G, H be drops placed any where in the conical superficies described by OG, OH, and be illuminated by the sun's rays, the angle SGO, being equal to the angle POG, or $50^{\circ} 57'$, shall be the least angle in which the then least refrangible rays can, after two reflections, emerge out of the drops; and, therefore, the least refrangible rays shall come most copiously to the eye from the drops in the line OG, and strike the senses with the deepest red in that region.

And the angle SHO being equal to POH, $54^{\circ} 7'$, shall be the least angle in which the most refrangible rays, after two reflections, can emerge out of the drops; and, therefore, those rays shall come most copiously to the eye from the drops in the line OH, and so strike the senses with the deepest violet in that region.

And, by the same argument, the drops in the region, between G and H, shall strike the senses with the intermediate colours, in the order which their degrees of refrangibility require; that is, in the progress from G to H, or from the inside of the bow to the outer, in this order: red, orange, yellow, green, blue, indigo, violet.

And since the lines OG, OH, may be situated any where in the conical surface; what is said of the drops and colours in these lines is to be understood of the drops and colours every where in this superficies.

Thus are formed two bows, an *interior* and stronger, by one reflection; and an *exterior* and fainter, by two; the light becoming weaker and weaker by every reflection.

Their colours will lie in a contrary order to one another; the first having the red without, and the purple within; and the second, the purple without, and red within; and so of the rest.

RAINBOW, Artificial. This doctrine of the rainbow is confirmed by an easy experiment; for upon hanging up a glass globe, full of water, in the sun-shine, and viewing it in such a posture as that the rays, which come from the globe to the eye, may, with the sun's rays, include an angle either of 42° , or 50° ; if, *e. gr.* the angle be about 42° , the spectator, supposed at O, will see a full red colour in that side of the globe opposite to the sun, as at F. And if that angle be made a little less, suppose by depressing the globe to E, the other colours, yellow, green, and blue, will appear successively, in the same side of the globe, also exceedingly bright.

But if the angle be made about 50° , suppose by raising the globe to G, there will appear a red colour in that side of the globe towards the sun, though somewhat faint; and if the angle be made greater, suppose by raising the globe to H, this red will change successively to the other colours, yellow, green, and blue.

The same thing is observed in letting the globe rest, and raising or depressing the eye so as to make the angle of a just magnitude.

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magnitude. Newton's Optics, part ii. prop. 9. prob. 4. p. 147, ed. 3.

RAINBOW, Dimension of the.—Descartes first determined its diameter by a tentative and indirect method; laying it down, that the magnitude of the bow depends on the degree of refraction of the fluid; and assuming the ratio of the sine of incidence to that of refraction to be in water as 250 to 187.

But Dr. Halley has since, in the Philosophical Transactions, N^o 267, given us a simple direct method of determining the diameter of the rainbow from the ratio of refraction of the fluid being given; or, *vice versa*, the diameter of the rainbow being given, to determine the refractive power of the fluid.

The principles of Dr. Halley's construction for this purpose, illustrated and facilitated by Dr. Morgan, bishop of Ely, will be understood from the following view of them. Let SN, *sn*, (Plate XVIII. Optics, fig. 5.) be two of the efficacious rays incident upon a drop of rain; these, when refracted to the same point F, and thence reflected to G, *g*, will have the parts within the drop on one side NF, *nf*, equal to those on the other side FG, *fg*, from the nature of the circle, and because the angles of incidence CFN, *CFn*, are equal to the angles of reflection CFG, *CFg*. And since the parts within the drop are equal and alike situated, they will be similarly situated with regard to the drop itself; and, consequently, as the incident rays SN, *Sn*, are supposed to be parallel, the emergent rays GR, *gr*, will be also parallel. From C, the centre, draw the radii CN, *Cn*, CF, then will CNF = CFN be the angle of refraction, and the small arc Nn is the nascent increment of the angle of incidence BCN; and as it measures the angle at the centre NCn, it is double of the angle at the circumference upon the same arc, *viz.* NF*n*, which is the nascent increment of the angle of refraction NFC. Farther, let the ray SN (fig. 6.) enter the lower part of the drop, and be twice reflected within the drop at F and G; then is the ray NF equal to the ray FG, and the arc NF = the arc FG. Draw *fg* parallel to FG, and it will be the reflected part of some ray *sn*, whose obliquity to the drop makes it cross the ray NF in its refraction; then will the part *nf* = *fg*, and the arc *nf* = *fg*, and the small arc F*f* = G*g*. Therefore, 2F*f* = (F*f* + G*g* = the arc FG - *fg* = NF - *nf*) Nn - F*f*; consequently Nn = 3F*f*, *i. e.* the nascent increment of the angle of incidence is equal to three times that of the angle of refraction. After a like manner it may be shewn, that after three, four, five, &c. reflections, the increment of the angle of incidence will be four, five, six, &c. times greater than that of the angle of refraction. Hence, in order to find the angle of incidence of an efficacious ray, after any given number of reflections, we are to find an angle whose nascent increment has the same ratio to the increment of its corresponding angle of refraction, generated in the same time, as the given number of reflections (*n*) increased by unity has to unity; *i. e.* as *n* + 1 to 1. But these increments are as the tangents of the respective angles directly. For, let ACD, ABD (fig. 7.) be the angles of incidence and refraction proposed; and if we suppose the line AC to move about the point A in the plane of those angles, the extremity of it, C, will describe the circular arc C*c*; and when AC is arrived at the situation A*c*, the line BD will be thereby removed into the situation B*d*. Draw *c*D, then is the angle ACD = ABC + CAB, and the angle A*c*d = AB*c* + *c*AB; therefore the excess of A*c*d above ACD, or the increment of ACD, is equal to both the angles CB*c* and CA*c*. But since the angle A*c*c differs infinitely little

from a right one, a circle described on the diameter AC shall pass through the points D and *c*; and, therefore, the angles CA*c*, CD*c*, (inscribing on the same arc C*c* of the said circle) will be equal; and, therefore, the increment of the angle ACD is equal to CB*c* + CD*c* = D*c*d. But the nascent angles D*c*d and DB*c* are as their sines, that is, as their opposite sides BD and D*c* = DC, the angle CD*c* being infinitely small; but BD : CD :: DE : DA (the line BE being parallel to AC) :: tangent of the angle EBD = ACD : tangent of the angle ABD. Therefore the increment D*c*d of the angle ACD is to the increment CB*c* of the angle ABD (generated in the same time) as the tangent of the former to the tangent of the latter directly. Hence the praxis is as follows:

First, *The ratio of the sine of incidence I, to the sine of refraction R, being given; to find the angles of incidence, and refraction of a ray, which becomes effectual after any given number (n) of reflections.*—Suppose any given line, as AC (fig. 8.) which divide in D; so as that AC : AD :: I : R; and again divide it in E, so that AC may be to AE as the given number of reflections, increased by unity, is to unity; *i. e.* as *n* + 1 : 1. Upon the diameter CE describe a semicircle CBE, and from the centre A, with the radius AD, describe an arc DB intersecting the semicircle in B; then drawing AB, CB, and letting fall the perpendicular AF on CB produced; ABC, or its complement to two right angles, ABF, will be the angle of incidence; and ACB the angle of refraction required. For, drawing BE parallel to AF, the triangles ACF and ECB are similar. Now, the sine of the angle ABC, or ABF, is to the sine of ACB as AC to AB = AD, *i. e.* as I to R; therefore if ABF be the angle of incidence, ACF will be the angle of refraction. Moreover, the nascent increment of ABF is to that of ACB (generated in the same time) as CF : BF :: CA : AE, on account of the similar triangles; *i. e.* as *n* + 1 to 1, by construction. The ratio, therefore, of the nascent increment of the angle of incidence ABF to that of the angle of refraction ACB, is that which is required in the angles of incidence and refraction of an efficacious ray, after a given number of reflections; consequently the angles ABF and ACF are those required. From this construction we may easily deduce Sir Isaac Newton's rule for finding the angle of incidence ABF. See his Optics, p. 148, 149.

For AC : AB :: I : R; whence $AC = \frac{I}{R} \times AB$;

and CF : BF :: *n* + 1 : 1; therefore CF = $\frac{n+1}{1} \times BF$; or (putting *n* + 1 = *m*) CF = *m* × BF; and, on account of the right angle at F, AC² - CF² = AB² -

BF², *i. e.* $\frac{I^2}{R^2} AB^2 - m^2 BF^2 = AB^2 - BF^2$; and,

therefore, $m^2 BF^2 - BF^2 = \frac{I^2}{R^2} AB^2 - AB^2$; and,

consequently, $\frac{BF}{AB} = \sqrt{\frac{II - RR}{m^2 R^2 - R^2}}$. Hence, because

in the first bow, the ray emerges after one reflection, we have *n* = 1, *m* = 2, *m*² = 4, and *m*² - 1 = 3; therefore, $\sqrt{3} RR : \sqrt{II - RR} :: AB : BF :: \text{radius} : \text{cosine of the angle of incidence}$. In the second bow, where there are two reflections, *m*² - 1 = 8; whence $\sqrt{8} RR : \sqrt{II - RR} :: AB : BF$. In the third bow, after three reflections, *m*² - 1 = 15; and $\sqrt{15} RR : \sqrt{II - RR} :: AB$

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∝ AB : BF, and so on for any given number of reflections. Wherefore, supposing the ratio of refraction to be, as sir Isaac Newton has determined it, viz. as 108 to 81 in the red rays, and as 109 to 81 in the violet rays; we shall have I (in the least refrangible rays) = 108, II = 11664; and R = 81, and RR = 6561, and $I^2 - R^2 = 5103$,

$\sqrt{3RR} = 140.3$, and $\sqrt{I^2 - R^2} = 71.4$: therefore,

As $\sqrt{3RR} = 140.3$, whose logarithm is 2.147045

Is to $\sqrt{I^2 - R^2} = 71.4$ - - - 1.853913

So is radius - - - 10.000000

To the cosine of the angle of incidence, } 9.706868
BAF = $30^\circ 37'$ - - - }

Hence the angle of incidence ABF is $59^\circ 23'$ in the red rays.

Secondly, *Having given the angle of incidence, and the ratio of I to R, or of refraction; to find the angle which a ray of light emerging out of a refracting sphere, after a given number of refractions, makes with the axis of vision, or an incident ray; and, consequently, to find the diameter of the rainbow.* The angle of incidence, and the ratio of refraction, being given, the angle of refraction is given; which angle being multiplied by double the number of reflections increased by 2, and double the angle of incidence subtracted from the product, the angle remaining is the angle sought.

In order to find the angle of refraction, say

As I = 108, whose logarithm is - 2.033424

Is to R = 81 - - - 1.908485

So is the sine of incidence $59^\circ 23'$ - 9.934798

To the sine of the angle of refraction $40^\circ 12'$ 9.809859

Then, making the angle CNF (fig. 9.) = $40^\circ 12'$, NF will be the refracted ray, which at F is reflected into FG, and at G emerges in GR. Produce the incident and emergent rays SN and RG, till they intersect each other at X, and as CF bisects the angle NFG, it will, if produced, bisect the angle SXR. Then CFN = CXN + FNX; but FNX = CNX - CNF, or CFN; therefore CFN = CXN + CNX - CNF; that is, $2CFN - CNX = CXN$; or $80^\circ 24' - 59^\circ 23' = 21^\circ 1'$ = CXN; therefore $2CXN = SXR = 42^\circ 2'$, which is the measure of the angle that the incident and emerging rays, which are the least refrangible, contain with each other. If instead of the ratio 108 to 81, we take that of

109 to 81, we shall find the values of $\sqrt{3RR}$, and $\sqrt{I^2 - R^2}$, such as will give the angle of incidence BCN, and the arc BN = $58^\circ 40'$, and the angle SXR = $40^\circ 17'$, for the most refrangible, or extreme violet rays.

If the ray be twice reflected, viz. at F and G, as in the production of the extreme bow, and emerges at H in the direction HA, intersecting the incident ray SN in Y, we may find the angle AYS thus: produce AH till it meets GX, produced in R; then in the triangle HGR, the external angle HGX = HRG + GHR. But because of equal angles of reflection at F and G, GHR = FGX, therefore HGX - FGX = HGF = HRG = 2CGF, or CNF. But SXR = 4CNF - 2CNX; therefore in the triangle YXR we have the two internal angles R + X = 6CNF - 2CNX = the external angle at Y, viz. AYN. In this case, to find the angles

of incidence and refraction, we have $\sqrt{8RR} : \sqrt{I^2 - R^2} :: \text{radius} : \text{cosine of the angle of incidence}$; whence the said angle will be found $71^\circ 50' = \text{CNX}$. And as 108 : 81 :: sine of $71^\circ 50'$: sine of $45^\circ 27' = \text{CNF}$, the angle

of refraction; therefore $6 \times 45^\circ 27' - 2 \times 71^\circ 50' = 129^\circ 3' = \text{AYN}$; and, therefore, its complement AYS = $50^\circ 57'$, the angle required for the least refrangible rays. But for the most refrangible rays, where I : R :: 109 : 81, we have the angle of incidence $71^\circ 26'$, and the angle of refraction $44^\circ 47'$; and, therefore, the angle AYS = $54^\circ 7'$. In the same manner the same angles are calculated after three or four reflections.

From the preceding problems we obtain the following results, viz.

I. Rainbow,	{ Red 42° 2' }	} The spectator's back being turned to the sun.
	{ Violet 40 17 }	
II. Rainbow,	{ Red 50 57 }	}
	{ Violet 54 7 }	

If the angle made by a ray, after three or four reflections, were required, and therefore the diameters of the third and fourth rainbow (which are scarcely ever seen, on account of the great diminution of the rays, by so many repeated reflections) they will be found,

III. Rainbow,	{ Red 41° 37' }	} The spectator being turned to- wards the sun.
	{ Violet 37 9 }	
IV. Rainbow,	{ Red 43 52 }	}
	{ Violet 49 34 }	

Dr. Morgan's Dissertation upon the Rainbow, among the notes upon Rohault's System of Philosophy, part iii. chap. xvii.

Hence, the breadth of the rainbows is easily found: for the greatest semi-diameter of the first bow, i. e. from red to red, being $42^\circ 2'$, and the least, viz. from violet to violet, $40^\circ 17'$, the breadth of the fascia or bow, measured across from red to violet, will be $1^\circ 45'$; and the greatest diameter of the second bow being $54^\circ 7'$, and the least $50^\circ 57'$, the breadth of the fascia will be $3^\circ 10'$. And hence the distance between the two will be found $8^\circ 55'$.

In these measures the sun is only esteemed a point; wherefore, as his diameter is really about $30'$, or $32'$, so much must be added to the breadth of each fascia or bow, from red to violet, and so much must be subtracted from the distance between them.

This will leave the breadth of the primary bow, $2^\circ 15'$; that of the secondary bow, $3^\circ 40'$; and the interval between the bows, $8^\circ 25'$; which dimensions, deduced by calculation, sir Isaac Newton assures us from his own observations, agree very exactly with those found by actual mensuration in the heavens. Optics, p. 153. ed. 3.

RAINBOW, *Particular Phenomena of the.* From this theory of the rainbow, all the particular phenomena of it are easily deduced: hence we see why the iris is always of the same breadth; because the intermediate degrees of refrangibility of the rays between red and violet, which are its extreme colours, are always the same. See Apparent MAGNITUDE.

Secondly, Why it is more distinctly terminated on the side of the red than on that of the violet? there being no efficacious rays in the space adjoining to the red drops, i. e. to the space between the bows, whence it terminates abruptly; whereas, in the space on the side of the violet ones, there are some rays emitted to the eye, which, though too feeble to affect it strongly, yet have this effect, that they soften the violet edge insensibly, so that it is difficult to determine precisely where it terminates.

Thirdly, Why the bow shifts its situation as the eye does; and, as the popular phrase has it, *flies from those who follow it; and follows those that fly from it?* the coloured drops being disposed under a certain angle about the axis of vision, which

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is different in different places: whence also it follows, that every different spectator sees a different bow.

Fourthly, Why the bow is sometimes a larger portion of a circle, sometimes a less? its magnitude depending on the greater or less part of the surface of the cone, above the surface of the earth, at the time of its appearance; and that part being greater or less, as the line of aspect, or axis of vision, is more inclined or oblique to the surface of the earth; which inclination, or obliquity, is greater as the sun is higher: whence, also, the higher the sun, always the less the rainbow.

Fifthly, Why the bow never appears when the sun is above a certain altitude? the surface of the cone, in which it should be seen, being lost in the ground, at a little distance from the eye, when the sun is above 42° high.

Sixthly, Why the bow never appears greater than a semi-circle, on a plane? since be the sun ever so low, and even in the horizon, the centre of the bow is still in the line of aspect; which, in this case, runs along the earth, and is not at all raised above the surface.

Indeed, if the spectator be placed on a very considerable eminence, and the sun in the horizon, the line of aspect, wherein the centre of the bow is, will be notably raised above the horizon (considering the magnitude of the circle whereof the bow uses to be a part). Nay, if the eminence be very high, and the rain near, it is possible the bow may be an entire circle.

Seventhly, How the bow may chance to appear inverted, *i. e.* the concave side be turned upwards? *viz.* a cloud happening to intercept the rays, and prevent their shining on the upper part of the arch: in which case, only the lower part appearing, the bow will seem as if turned upside down; which, probably, has been the case in several prodigies of this kind, related by authors.

Indeed the bow may appear inverted from another cause: for, if when the sun is $41^\circ 46'$ high, his rays fall upon the smooth surface of some spacious lake, in the middle of which a spectator is placed; and if, at the same time, there be rain falling, to which the rays may be reflected from the lake, it will be the same as if the sun should shine below the horizon, and the line of view be extended upwards: thus the surface of the cone, wherein the coloured drops are to be placed, will be wholly above the surface of the earth.

But since the upper part will fall among the unbroken clouds, and only the lower part be found among the drops of rain, the arch will be inverted.

Eighthly, Why the bow sometimes appears inclined? the accurate roundness of the bow depending on its great distance, which prevents us from judging of it exactly; if the rain, which exhibits it, chance to be much nearer, we shall see its irregularities; and if the wind, in that case, drive the rain so that the higher part be farther from the eye than the lower, the bow will appear inclined.

Ninthly, Why the legs of the rainbow sometimes appear unequally distant? if the rain terminate on the side of the spectator, in a plane so inclined to the line of aspect as to make an acute angle on the left hand, and an obtuse angle on the right, the surface of the cone, which determines what drops will appear, will fall upon them in such manner as that those on the left hand will appear farther from the eye than those on the right. For the line of aspect being perpendicular to the plane of the bow, if you suppose two rectangular triangles, a right and left, the cathetus of each to be the line of view, and the base of the semi-diameter of the bow, inclined as above; it is evident, since those angles of the triangles, next the eye, must always be the same (*viz.* 43° in the inner bow), the basis of the 'right-hand

triangle will, in this case, appear much longer than that of the left.

Dr. Langwith, in the *Phil. Trans.* N^o 375, describes a remarkable rainbow, in which he observed several series of colours, which increased the bow to a breadth far exceeding what had been determined by calculation. The colours of the primary rainbow, he says, were as usual; under this was an arch of green, and then alternately two arches of reddish-purple, and two of green, and under all a faint appearance of another arch of purple. The order of the colours was, 1. Red, orange, yellow, green, light blue, deep blue, and purple. 2. Light green, dark green, and purple. 3. Green and purple. 4. Green, and faint vanishing purple.

M. Bouguer frequently saw a phenomenon of this kind, when he was upon the mountains of Peru, where the sky is often extremely serene. Similar appearances have been also observed by others. Dr. Pemberton has attempted to explain them by means of the Newtonian doctrine of fits of easy reflection and transmission; but he goes upon the supposition that the differently-coloured rays have their separate fits, on their arrival at the surface of any medium, without any regard to the thickness of it; whereas it is plain, that, in such a case, all kinds of rays are reflected or transmitted promiscuously. It is most probable that these colours are formed in very minute drops of water or vapour, intermixed with the larger drops, that their formation depends upon the same principle with the colours of thin plates, and that they are similar to those of several kinds of halos. Dr. Pemberton himself observes, that it is most likely that these additional rings of colours are formed in the vapour of the cloud, which the air, being put in motion by the fall of the rain, may carry down along with the large drops. This, he says, may be the reason why these colours appear under the upper part of the bow only, this vapour not descending very low. As a farther confirmation of this, these colours, he observes, are seen strongest when the rain falls from very black clouds, which cause the fiercest rains; by the fall of which the air will be most agitated. *Phil. Trans. abr. vol. vi. p. 140.* Priestley on Light and Colours, p. 593.

It has been a subject of controversy among biblical critics, whether the antediluvian atmosphere presented any such phenomenon as a rainbow. The occasion of this debate is a passage in Genesis, ch. ix. 12—17. Mr. Whitelurst, in his "Inquiry into the original State and Formation of the Earth, &c." attempts to establish the probability that the antediluvian atmosphere was so uniformly temperate, as to be subject to no storms, tempests, or rain. The opinion is by no means probable, nor does the above-cited passage warrant any such conclusion. The rainbow was then made the sign or token of God's covenant with Noah, that no such calamity should again take place. אֶת denotes a sign or token, and in this sense it is used in the case of Cain, Gen. iv. 15. The mark set upon Cain was, as Shuckford conceives, a sign or token (אֶת) given to him, that he should be preserved from the evil which he deprecated.

RAINBOW, Lunar. The moon sometimes also exhibits the phenomenon of an iris, or bow, by the refraction of her rays in the drops of rain in the night-time.

Aristotle says, he was the first that ever observed it; and adds, that it never happens, *i. e.* is never visible, but at the time of the full moon; her light, at other times, being too faint to affect the sight after two refractions, and one reflection.

The lunar iris has all the colours of the solar, very distinct and pleasant; only faint, in comparison of the other; both

both from the different intensity of the rays, and the different disposition of the medium.

In that mentioned, *Philosophical Transactions*, N° 331, Mr. Thoresby observes, the largeness of the arch was not so much less than that of the sun, as the different dimensions of their bodies, and their distances from the earth, should seem to require; but as to its entireness, and the beauty of its colour, it was admirable. This continued about ten minutes before the interposition of a cloud hindered its observation.

RAINBOW, Marine. The marine or sea-bow is a phenomenon sometimes observed in a much agitated sea; when the wind, sweeping part of the tops of the waves, carries them aloft; so that the sun's rays, falling upon them, are refracted, &c. as in a common shower, and paint the colours of the bow.

F. Bourzes, in the *Philosophical Transactions*, observes, that the colours of the marine rainbow are less lively, less distinct, and of less duration, than those of the common bow; that there are scarce above two colours distinguishable, a dark yellow on the side next the sun, and a pale green on the opposite side.

But these bows exceed as to number, twenty or thirty being sometimes seen together: they appear at noon-day, and in a position opposite to that of the common bow, *i. e.* the concave side is turned upwards, as indeed it is necessary it should be, from what we have shewn in accounting for the phenomena of the solar bow. A coloured bow is always to be seen in the scattered water of a jet, a broken cascade, and the like, when the sun and the spectator are in proper situations.

To this class of bows may be referred a kind of white or colourless rainbows, which Mentzelius, and others, affirm to have been at noon-day. M. Mariotte, in his fourth *Essai de Physique*, says, these bows are formed in mists, as the others are in showers; and adds, that he has seen several, both after sun-rising, and in the night.

The want of colours he attributes to the smallness of the vapours which compose the mist; but we should rather account for it from the exceeding tenuity of the little vesiculae of the vapour; which being, in effect, only little watery pellicles bloated with air, the rays of light undergo but little refraction in passing out of air into them; too little to separate the differently-coloured rays, &c.

Hence, the rays are reflected from them, compounded as they came, that is, white.

Rohault mentions coloured rainbows on the grafs, formed by the refractions of the sun's rays in the morning dew. *Trait. de Phys.*

Rainbows have been also produced by the reflection of the sun from a river; and in the *Philosophical Transactions*, vol. l. p. 294. we have an account of a rainbow, which must have been formed by the exhalations from the city of London, when the sun had been set twenty minutes, and consequently the centre of the bow was above the horizon. The colours were the same as in the common rainbow, but fainter.

The best way of forming a resemblance of a rainbow is to fasten a number of small solid glass balls, or a number of small glass bubbles full of water, upon a dark board, and to present the board thus furnished to the sun at a proper inclination, which experience easily finds, whilst you turn your back to the sun, and look at the board.

RAINFELDEN, in *Geography*, a town of Austria; 2 miles W. of Hainfelden.

RAINHAM, a township of Norfolk county, in Upper

Canada; being the first township fronting on lake Erie, west of the grand river Lands.

RAINSBRON, a town of Germany, in the margraviate of Anspach; 3 miles N. of Creglingen.

RAINY LAKE. See *Le PLUVE*.

RAJODE, a town of Hindoostan, in Malwa; 30 miles E. of Tandla.

RAJOORA, a town of Hindoostan, in Dowlatabad; 18 miles W.N.W. of Kondur.—Also, a town of Bengal; 65 miles N. of Dacca.

RAJOUR, a town of Hindoostan, in Lahore; 36 miles N.W. of Jummo.

RAJOWLY, a town of Hindoostan, in Bahar; 30 miles S. of Bahar.

RAJPOOTANA, a country of the Rajpoots, generally denoting *Agimere* (which see), and the original country of the founder of the Mahratta state, whose rulers, about half a century ago, aspired at universal empire in Hindoostan; but they have been reduced to their present low state, by the depredations of Mahratta detachments, which, being composed of light horse, and accustomed to separate into small parties, have, by their desultory movements, at once spread desolation, and eluded the attacks of the inhabitants. This is the fact with regard to the open parts of Rajpootana; the mountainous parts remaining free from their incursions.

Rajpootana was divided into three great principalities, under the names of Oudipour, Joodpur, and Ambeer (or Amere), now better known by that of Joinagur, or Jyenagur. (See each respectively.) In Acbar's division of the empire, these principalities were classed as belonging to the foubah of Agimere, sometimes called Marwar. It is not easy to assign the precise limits and dimensions of these principalities, which occupy the space between the western confines of Agra and the north-east part of Guzerat, and between the sandy desert (or Registan) and Malwa; that is, an extent of 330 British miles from N.E. to S.W., and 200 broad in the widest part. Jyenagur or Jypour lies to the N.E., Oudipour to the S.W., and Joodpur to the N.W., bordering angularly on the other two. Pere Wendell's MS., cited by Rennell, states the revenues of Oudipour at 10 lacks of rupees, Marwar at 40, and Jyenagur at 40, *per annum*, in the year 1779. The whole revenue of the foubah of Agimere, in the time of Acbar, appears to have been only about 75 lacks. Aurungzebe is said to have doubled the land-tax on the Rajpoots, and accordingly in Mr. Frazer's account, Agimere is stated at 163 lacks of rupees. The two former, *viz.* Oudipour and Marwar, are very mountainous, with a sandy soil in the vallies; the latter is the most fertile, and was, about the middle of the last century, in a high state of improvement, under the government of the celebrated rajah Jyefing, or Jessing, who founded the new capital of Jypour, whence the name of the province was changed to that of the capital. Jypour was a place of great wealth and commerce in 1779, being the entrepot of the principal part of the goods that are brought from every quarter of India. The rajah built an observatory in his capital; but the confusions that have so long prevailed in this province, must have greatly reduced the wealth and importance of the capital. Sindia, as Rennell informs us, received the tribute of all the three Rajpoot provinces, and converted it to his use; and he also made considerable conquests in them, particularly in Jyenagur. In early times the whole Rajpootana probably constituted one entire kingdom, or empire, under the rana or prince of Oudipour, the head of the Rajpoot states; the antiquity of whose house may be inferred from the name

Rhanna appearing in Ptolemy, nearly in its proper position, as a province. See OUDIPOUR.

The province of Agimere in general (see AGIMERE) has ever been the country of the Rajpoots; that is, the warrior tribe among the Hindoos, and which are noticed in Arrian and Diodorus; and Cheitore, or Oudipour, (considered by Rennell as synonymous,) is, in his opinion, reckoned the first among the Rajpoot states. (See CHEITORE.) From the Ayin Achee we derive some new ideas respecting the division of the foubah of Agimere. It consisted at that time of three grand divisions, Marwar, Meywar, and Hadowty (or Nagore); and these contained seven circars or subdivisions, Agimere, Cheitore, Rantampour, Joudypour, Sirowy, Nagore, and Beykeener (or Bicaner). Marwar, as including the circar and fortrefs of Agimere, has become almost synonymous with Agimere, in common acceptation. The extent of this province, as given by the same book, is 168 coffes, or about 320 British miles, from E. to W.; and 150 coffes, or 285 British miles, from N. to S. Such is the province of the Rajpoots. From the indulgence granted to this tribe throughout India, *viz.* that of feeding on goats' flesh, it may be inferred, says Rennell, that the custom originated in this mountainous country. The grain cultivated there is chiefly of the dry kind. The taxes amounted, in the time of Achar, to no more than a seventh or eighth of the produce of the harvest. Rennell's Memoir.

RAJPOOTS, the inhabitants of *Rajpootana*; which see. They were not confined entirely to the foubah of Agimere; as some inferior tribes of them are settled in Bundelcund, and in Gurry-Mundella. Others, according to Thevenot, are settled in Moultan; and indeed he represents Moultan as the original country of the Kuttries, from whom the Rajpoots sprung.

The Kuttries or Catries, who formed a particular sect of Hindoos at Moultan, were the Cathari of Diodorus, and the Cathi of Arrian, with whom Alexander carried on war, on the borders of the Malli. The Rajpoots are ordinarily divided into two tribes or classes, *viz.* those of Rathore, and Chohan or Seefodya. Marwar, or the N.W. division of Agimere, is the proper country of the former; and Meywar, or Oudipour, of the latter. The Rathore tribe were originally the most numerous of the two; and it has been said by colonel Dow, among others, that the Mahratta chiefs had their origin from the Rathore tribe: and in proof of this it has been alleged, that the etymology of the name Mahratta has been deduced from Rathore, prefixing to it "maha," or great. (See MAHRATTA.) The Rajpoots are represented by Thevenot as having spread from Moultan, their proper country, over all the Indies. Diodorus Siculus distinguishes them by the custom of their women burning themselves alive, on the funeral piles of their husbands; which is indeed a custom among them, as well as some other Hindoos, at this day. Rennell.

RAJPOUR, a town of Bengal, on the bank of the Ganges; 10 miles N.N.E. of Curruckdeagh.

RAISE, in the *Manege*, is used for working. See RAISING.

RAISE is likewise used for placing a horse's head right, and making him carry well, and hindering him to carry low, or to arm himself.

RAISE *Tacks and Sheets*, in *Sea Language*, the order to let them go in the article of tacking, that the sails may be set on the contrary tack they were on before.

To RAISE a *siege*. See SIEGE.

RAISED AIRS. See AIR.

RAISED PLAN. See PLAN.

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RAISEEN, in *Geography*, a town of Hindoostan, in Malwa; 15 miles S. of Biffah. N. lat. 23° 16'. E. long. 77° 49'.

RAISER, in *Building*, a board set on edge under the fore-side of a step, a flair, &c. See STAIR, &c.

RAISIN, in *Geography*, a river of America, which runs into lake Michigan, N. lat. 43° 12'. W. long. 85° 42'. —Also, a river of America, which runs into lake Erie, N. lat. 43° 20'. W. long. 82° 55'.

RAISIN *Island*, a small island in lake St. Francis. N. lat. 45° 6'. W. long. 74° 27'.

RAISIN, or *Raisin, Market*, a small market-town in the east division of the wapentake of Walthcroft, parts of Lindsey, and county of Lincoln, England, is situated on the banks of the river Raifen, whence it derives its name, at the distance of 15 miles N.E. from Lincoln, and 149 miles N.W. from London. According to the population returns of 1811, it contains 164 houses, and 964 inhabitants. Here is a weekly market on Thursday, and there are fairs every alternate Tuesday, after Palm Sunday, and on the 25th of September. The church is an ancient structure, and is remarkable for the peculiar form of the upper windows in its embattled tower. These have a pointed arch, divided into two pointed lights, and a quaterfoil head. Up the centre runs a strong mullion, crossed by a transom, terminating at the impells, as happens in the church of Yarbrough, near Louth, which renders it probable that both edifices were erected by the same architect. The living is a vicarage in the gift of the crown; and by the endowment the vicar is entitled to the unusual tythe of ale. Besides the church, there are in Raisin a Roman Catholic chapel, and a Methodist's meeting-house; also a free-school, and an hospital for poor old men.

At a short distance from Market-Raisin, are the villages of Middle and West Raisin. Middle Raisin was formerly divided into two parishes, called Drax and Tupholm, but these are now united. At Tupholm stood an abbey of Premonstratensian canons, which was founded in the reign of Henry II., by Alan de Neville, and his brother Gilbert. Previous to the dissolution, it was inhabited by nine monks, whose annual income, according to Speed, amounted to 119*l.* 2*s.* 8*d.* The church is a small, but ancient building, consisting of a nave and chancel, which are separated by elegant screen work, beneath a pointed arch, supported by circular columns. The nave appears to have had side-aisles, as the pillars and pointed arches stand in relief from the present wall.

The principal seats in this vicinity are Willingham-house, a seat of the Boucherett family; and Thurgundy, the property of lord Middleton. The latter anciently belonged to the Willoughbys. The house is situated on an eminence, commanding an extensive view over the vale to Swinhop, and is surrounded by pleasure-grounds, finely varied by wood and lawn. Beauties of England and Wales, vol. ix. by John Britton, 1807.

RAISING, in the *Manege*, one of the three actions of a horse's legs; the other two being the flay, and the tread. The raising or lifting up of his legs in caprioles, curves, &c. is esteemed good, if he perform it hardily, and with ease; not crossing his legs, nor carrying his feet too much out or in; yet bending his knees as much as is needful.

RAISING the Land, in *Sea Language*. See Laying the LAND.

RAISING a *Purchase*, denotes the act of disposing certain instruments or machines in such a manner, as that, by their mutual efforts, they may produce a mechanical force suffi-

cient to overcome the weight, or resistance, of the object to which the machinery is applied.

RAISING-Pieces, or *Reason-pieces*, in *Architecture*, are pieces that lie under the beams, and over the potts or puncheons: those lying on the brick-work are called platbands.

RAISINS, grapes prepared by drying them in the sun, or in the air; to fit them for keeping, and for some medicinal purposes.

Of these there are various kinds: as, raisins of Damascus, thus called from the capital city of Syria, in the neighbourhood of which they are cultivated. They are much used in the composition of ptisans, together with jujubes and dates; they are brought flat, and seeded, of the size of the thumb; whence it is easy judging of the extraordinary bulk of the grape, when fresh. Travellers tell us of bunches weighing twenty-five pounds. Their taste is faintish and disagreeable.

Raisins of the sun are a kind of raisins brought from Spain, of a reddish or blueish colour, seeded, and very agreeable to eat.

There are various other sorts, denominated either from the place where they grow, or the kind of grape, &c. as raisins of Calabria, Muscadine raisins, &c.

The finest and best raisins are those called in some places Damascens and jube raisins. These are the fruit of the *vitis Damascena*, and are distinguishable from the others by their largeness and figure; they are flat, and wrinkled on the surface; soft and juicy within, near an inch long, and semipellucid, when held against a good light; they have a sweet, agreeable, and vinous taste; and when fresh, and growing on the bunch, are of the size and shape of the large olive.

The common raisins are the fruit of several species of grape, which are better or worse, according as they have been more or less carefully cured. The raisins of the sun, or jar-raisins, so called, because they are imported in jars, are all dried by the heat of the sun; and these are the sorts used in medicine.

The common way for drying grapes for raisins is to tie two or three bunches of them firmly together, while yet on the vine, and dip them into a hot lixivium of wood-ashes, with a little olive oil in it. This disposes them to shrink and wrinkle; and after this they are left on the vine three or four days, separated on sticks in an horizontal situation, and then dried in the sun at leisure, after being cut from the tree. Some raisins are dried by the heat of an oven; and the difference between these and such as are dried in the sun, is obvious; the latter are sweet and pleasant, but the former have a latent acidity with the sweetness, that renders them much less agreeable. See **CURRENTS**.

All the kinds of raisins have much the same virtues; they are nutritive and balsamic, but they are very subject to fermentation with juices of any kind; and hence, when eaten immoderately, they often bring on colics. They are allowed to be attenuant, and are given in cases where the humours are too thick and viscid, and they are said to be very good in nephritic complaints; they are, however, too familiar in our foods, to be much regarded at present as a medicine. They are an ingredient, indeed, in our pectoral decoctions, and in some other medicines of that intention; in which cases, as also in others where astringency is not required of them, they should have the stones carefully taken out. They are used in some compositions rather with an intent of taking off the nauseous taste of other ingredients, and for obtunding their acrimony, than of doing any extraordinary service themselves.

RAISIN-Brandy, a name given by our distillers to a very clean and pure spirit, procured from raisins fermented only with water. Thus treated, they yield a spirit, scarce at all distinguishable from some of the wine-spirits; for there are as many kinds of wine-spirits as there are of grapes. The coarser the operation of distilling is performed in this case, the nearer will be the resemblance of the wine-spirit; that is, there will be most of this flavour in the spirit, when as much as can be of the oil is thrown up with a galloping heat.

The distillers are very fond of the wine-spirit, with which they hide and disguise the taste of their nauseous malt, and other spirits; and in defect of that spirit, this of raisins, made in this coarse manner, will go almost as far. It is indeed surprizing how extensive the use of these flavouring spirits is, ten gallons of raisin-spirit, or somewhat less of the wine-spirit, being often sufficient for a whole pipe of malt-spirit, to take off its native flavour, and give it an agreeable vinosity. It is no wonder, therefore, that the distillers, and ordinary rectifiers, are so fond of this, as it is a good cloak for their defects, and the imperfection of their processes.

When raisin-brandy is intended for common use, the fire should be kept slower and more regular in the distillation; and the spirit, though it hath less of the high flavour of the grape, will be more pleasant and more pure.

RAISIN-Wine. See **WINE**.

RAIT, in *Rural Economy*, a term used to signify the process or operation of dissipating the sap of vegetables, by exposure to moisture, or the influence of the atmosphere. It is mostly applied to hemp, flax, or other similar substances, and sometimes to hay, when it has been much exposed to alternations of wet and dry weather.

When the process is performed by means of water, as is mostly the case with hemp, frequently but not always with flax, and occasionally with other articles of the same nature, it is usually denominated water-raiting, and the article is said to be *water-raited*; but where it is effected by exposure to the air, upon the ground, when spread out, it is generally called ground-raiting, and the substance is said to be *ground-raited*. In the performance of these operations or processes with hemp, flax, and such like substances, there is great nicety and attention required to see that they are carried to a sufficient length, without going too far, so as to injure the textures of the substances in their cortical parts. This may probably be accomplished with the greatest certainty by the frequent examination of the materials themselves; keeping them perfectly under the water in the former case, and frequently turned with new surfaces to the atmosphere in the latter, never having the grassy surface on which they are spread out of too great a length. The effects of heavy rains, when long continued, must likewise be carefully attended to in this latter instance. See **FLAX**, **HEMP**, and **WATER-raiting**.

RAITAPOUR, in *Geography*, a town of Hindoostan, in the circle of Rajamundry; 12 miles N. of Rajamundry.

RAITCH, in *Rural Economy*, a term signifying a line or list of white, down the face of a horse. It is a very common mark in the faces of horses.

RAITENBACH, in *Geography*, a town of Germany, in the principality of Culmbach; 8 miles E.N.E. of Wunsiedel.—Also, a town of Bavaria, in the bishopric of Aichstadt; 8 miles N. of Aichstadt.

RAITENBURG, a town of the duchy of Carniola; 3 miles N. of Rudolfswerth.

RAITING, GROUND, in *Rural Economy*, that method of raiting or accomplishing the separation of the barks or coverings of the stems of flax, hemp, and other similar plants, by

by means of spreading them out in a thin manner upon close grassy surfaces, instead of putting them into ponds or pools of stagnant water, in order that they may be exposed to the atmosphere. It is occasionally employed for flax and other small stalked plants, but seldom or never for hemp and those which have large ones. It is a practice which stands in need of considerable attention and management. See RAIT.

RAJUAPOUR, in *Geography*, a town of Mocaumpour; 18 miles S. of Bargao.

RAIVATA, in *Hindoo Mythological History*, one of the faints or fages included in the denomination of Menus. Rivaiva is said to have been the son of Agni, the regent of fire, also called *Pavaka*, (which see), and *Mennu*.

RAJYA, in *Geography*, a town of Hindoostan, in Bahar; 20 miles E.S.E. of Bahar.

RAKAPORAH, a town of Hindoostan, in the circle of Jushpore; 10 miles N.E. of Odeypore.

RAKAS, a town of Transylvania, on the Alaut; 16 miles N.W. of Cronstadt.

RAKE, in *Agriculture*, a tool of the toothed kind, made use of for many purposes of husbandry, as for collecting together hay, corn, stubble, roots, leaves, and other similar sorts of materials. It is a very useful and convenient kind of tool in all such intentions. There are many descriptions of this sort of implement.

RAKE, *Bean-Stubble*, a tool of the rake kind, constructed for the purpose of clearing bean-stubbles. It is employed on some farms in Essex, as by Mr. Ketcher, at Burnham, where it is found to be well adapted to this use, and to do its work in a perfect manner. The head, which is seven feet eight inches in length, is formed with a very slight curve, having teeth set in it rather a close manner, which are one foot and a half in length, bending or curving a little forwards at the points. It is attached by a frame to the axle of the wheels, which is three feet two inches long; and the wheels are two feet six inches in their diameter. The hooks and shafts for the horse are four feet in length. This is a very simple construction of this nature, and one which is capable of easy application. The teeth should be made strong, whether they are of wood or iron. This is an implement which wants to be better known in other districts.

RAKE, *Corn*, a large strong rake, made use of in different districts for bringing together the mown grain crops. It is sometimes constructed with wooden teeth, but a better mode is to have them of iron, being a little bent forward, having the length of seven or eight inches. As it requires much exertion to perform the work with them, they should always be made as light as possible, so as to have sufficient power to perform the work. It has been stated by Mr. Somerville, in his *Agricultural Survey of the District of East Lothian*, that though the common hay-rake is mostly used there, a different kind for grain has been partially tried, and found to answer the purpose much better. In this, the length of the head is from ten to fifteen feet, the handle about seven feet, with a piece of wood across the end of it, by which it is drawn by two men. The teeth are of wood or iron; the last are the best, as well as the most durable, and are a little bent forward at the point, which gives them the power of retaining and carrying the ears along with them, much better than they would otherwise do. To make clean work, especially if the ridges are gathered, the field is raked across: in that way, every thing is taken up. But when it is preferred to draw the rake in the direction of the ridges, it may be considerably improved, by cutting the head into two or three lengths, and joining them with hinges, which will allow it to bend and accommodate itself to the curvature of the ridges. The advantage of this kind

of rake has been found considerable, even in cases where every possible attention has been paid to the cutting of the crop; but it frequently happens, that, owing to the dampness, greenness of the straw, or a foul grassy bottom, it is necessary to leave the crop unbound for a day or two, during which, if it be overtaken by a high wind, much of it will be scattered and lost, unless considerable pains are taken to gather it by hand-raking, or otherwise. Where the long rake is used for that purpose, the expence will in no instance, he thinks, exceed four-pence sterling per acre. An experiment made on a field of 30 acres, will convey some idea of the benefit that may be derived from the use of that instrument. The field was in barley, and the rakings, when threshed, yielded

	£	s.	d.
7½ bolls, fold at 28s. per boll	-	-	10 10 0
150 stones straw, fold at 6d. per stone	-	-	3 15 0
Total produce	14	5	0
Expence of raking 31 acres, at 4d. per acre	0	10	4
Bread and beer to the rakers	0	1	6
Carting from the field, stacking, &c.	0	2	6
Threshing	0	7	6
Total expence	1	1	10

Which deducted from 14l. 5s., leaves a profit of 13l. 3s. 2d. sterling. It is necessary to observe, that about ten acres of the field were left unbound, and a good deal disordered by a high wind; but as considerable pains were taken in the binding, the proportion obtained from these ten acres did not greatly exceed what was got from the rest of the field, the whole of which was cut with a great deal of care.

But though this mode of working the rake affords considerable profit and advantage, they would be a great deal more, by having recourse to horses in the draught of them. One horse in each would do as much labour as several men, in a given time; and by having shafts and low wheels fixed to the tool, it could be readily adapted to this method of being wrought.

RAKE, *Couching*, a large sort of strong horse-rake, with long round tines or teeth, crooked or bent forward in a gentle manner, and placed about two inches distant from each other; and a small beam in the middle, with side pieces, and an apparatus for attaching the horse to it. It is found very useful in bringing together the roots of couch, and other weeds, in order to their being burnt, or carried off the land, and in other ways destroyed. See *Couch-Rake*, *QUITCH-Rake*, and *RAKE-Twitch*.

RAKE, *Dew*, a sort of large rake, or hand drag, so named from being used before the dew is off the ground, or other sort of harvest work can be begun. It is a powerful convenient sort of implement for harvest work.

RAKE, *Garden*, a well-known sort of tool for raking the ground, as well as for putting in seeds, &c. In order to suit every kind of gardening work with rakes, there should be three or four different sizes, from about six to eighteen inches long in the head, having handles from six to eight feet in length, and the heads toothed with iron teeth: two or three inches long, being placed from one to two inches asunder, according to their respective sizes. The first or largest rake should have the head about fifteen to eighteen inches long, the teeth three inches, and placed two inches asunder, which is proper for raking stubborn or rough dug ground, and for putting in large kinds of seeds, raking off large weeds after hoeing, and many other purposes.

poses in large gardens. The next size should have the head twelve inches long, the teeth three inches, being placed one inch and half asunder, which is proper for all common raking in ordinary light ground, and for raking in most kinds of small seeds, as well as other purposes. A third sort of small rake should have the head about nine inches long, the teeth two and a half, being placed one inch asunder; proper for fine-raking beds, borders, &c. and raking in some particular fine seeds; as well as between rows, &c. of certain plants occasionally, where larger rakes cannot be introduced. And the smallest sort should have the head six inches long, the teeth two and a half, and placed one inch asunder; being very useful for raking between small plants in beds and borders, and other small parts, where the plants stand close, as well as several other purposes of that kind.

It may be noticed, that all these sorts of rakes are constructed both with wooden heads and iron teeth, and with the heads and teeth wholly of iron in both; of which the teeth are generally flattened, the back edge rounded off, and narrowing gradually to the point; the other straight, and placed on the heads edgeways across, with the back edge outward, and with the points all inclining very moderately inward, in a regular manner: the wooden-headed rake having each end of the head hooped with a thin flat iron ring, to secure it from splitting. It is very seldom that wooden teeth are employed in this way, or for these uses.

Those of the first sort are generally the lightest and cheapest, being proper for any kind of garden raking; but the latter, or iron-headed rakes, when made neat and as light as possible, with the teeth well set, in a proper position, and firmly fastened, are equally proper, and in some cases preferable, as in some wettilh or moist soils, as not being liable to clog so much as wooden rakes, and at the same time more durable. They are, however, more proper for middling and small rakes than for large ones; as, in strong raking, the teeth are more liable to get loose than in the wooden-headed rakes. Both the sorts, in their different sizes, are sold at the principal ironmongers' shops, both with and without handles.

And rakes having the heads, teeth, and handles, wholly of wood, may sometimes be used for particular purposes; such as raking in light kinds of kitchen-garden seeds in light ground, and taking off large hoed-up weeds in wide clear spaces, raking up swarths of mowed short grass before the sweepers, also fallen leaves of trees in autumn, and clippings of hedges, &c. as well as several other uses about the pleasure-garden.

RAKE, Hay, a well-known tool, with short teeth and a long handle, made use of in making hay. It is usually made of willow, or some other similar wood, in order that it may be light and handy. The teeth should not be too long, as, when that is the case, they are apt to hang and pull among the stubs of the grass in raking with them, and thereby retard the operation, as well as cause much fatigue to the labourer.

Different improvements have been made on this implement. A late useful alteration is the making the teeth to screw into the head, and fasten with screw nuts, by which the inconvenience of their dropping out in dry seasons is obviated. It has been observed, that with the spring-toothed rake, the operator is capable of performing much more work than by the common one. They are likewise capable of being conveniently made use of both for hay and corn. They were originally made and sold by Mr. Cort, of Leicester.

Another improvement is mentioned in Young's Agricultural Report of Norfolk, which is the addition of wheels. It is stated, that the "hand wheel-rake" of Fleg is an ex-

cellent implement for both hay and corn: it is to answer the purpose of the common hay-rake, and is about four feet long in the rake; and the two wheels, of nine inches diameter, so fixed, that the teeth are kept in any posture, at the will of the holder.

In some parts of Lancashire, they make use of a large horse-rake for collecting the hay together, and raking it up from the ground, which is found to be highly convenient and beneficial; as one horse, in one of these rakes, will perform as much labour as a great number of men, in a certain space of time; and besides the expedition, the work is considerably better done, in consequence of the greater weight of the implement.

The head of the rake has something of a large easy half circular form, into which two strong pieces of wood are fastened, which constitute the shafts for the horse. There are two low wheels behind, and the head has long teeth, curving a little forward, fixed into it at two or three inches from one another. The teeth may be made either of wood or iron, and should have considerable strength. The whole has no very great weight, though it must obviously be considerably heavier than the common rake; which is found of much advantage in its working, as has been hinted at above.

RAKE, Horse, an implement used in Norfolk and Suffolk, on the large and middling-sized farms, and, from its great utility, extending itself into other districts. It is employed for barley and oat crops, being drawn by a horse. And it has been stated by Mr. Young, that one man and a horse, driven by means of a line or rein, are capable of clearing from twenty to thirty acres, in a moderate day's work; the grain being deposited in regular rows or lines across the field, by simply lifting up the tool, and dropping it from the teeth, without the horse being stopped. It cost from four to five pounds.

Figures of it may be seen in the above Agricultural Reports. Horses have now been employed for working other sorts of rakes, and found of great advantage, as has been already seen.

RAKE, Horse Stubble, a large heavy kind of horse-rake, having strong iron teeth, fourteen or fifteen inches in length, placed at five or six inches from each other, and a beam four inches square, and eight or ten feet in length. In drawing it, two horses are mostly made use of, by which it is capable of clearing a considerable quantity of stubble in a short time. Tools of this sort are highly useful on corn farms, for collecting this useful material, and should be much more frequently employed than they are at present.

RAKE, Twitch, a large horse-rake, employed in certain cases for clearing lands from the roots of couch, twitch, or quitch-grass, as well as those of other sorts. It is constructed in different ways, as with one or two rows of teeth; but the latter is probably the best method, as by placing one row opposite the intervals of the other, it must be rendered a very effective tool.

RAKE of a Ship, is so much over her hull as overhangs at both ends of her keel.

That part of it which was before, is called the *rake forward-on*; and that part which is at the setting on of the stern-post, is called her *rake aft*, or *afterward-on*.

When a ship hath but a small rake forward-on, but is built with her stern too straight up, she is called *bluff-headed*.

RAKE of the Rudder, is the hindermost part of it.

RAKE, among Hunters. See **RAC**.

RAKE, in the Manege. A horse rakes, when being shoulder-splaid, or having drained his fore-quarter, he goes so lame, that he drags one of his fore-legs in a semicircle; which

which is more apparent when he trots, than when he paces.

RAKE, or *Vein*, in *Geology*, the most common repository of metallic ores. These veins intersect mountains nearly vertically, or more or less inclined from the perpendicular. They are filled with ores, intermixed with the peculiar minerals accompanying each kind of metal. They vary from a few inches to some feet or yards in width, and extend to a very considerable depth and distance. The upper side of the vein is provincially called the *hanger*, and the lower side the *ledger*; and the inclination from the perpendicular is called the *bede* of the vein. For a particular account of the structure and formation of veins, see **VEINS**, *Metallic*.

RAKEL, in *Geography*, a town of Dobruzzi Tartary, on the Danube; 15 miles W. of Isakzi.

RAKESBURG, or **RAKELSPURG**, a town of the duchy of Stiria, situated on an island in the Muehr; the inhabitants of which carry on a considerable trade with Hungary and Croatia; 36 miles S.E. of Gratz. N. lat. $46^{\circ} 45'$. E. long. $15^{\circ} 36'$.

RAKING signifies sloping or winding, as when a wall is not built up right or straight.

RAKING, in *Agriculture*, the operation of performing work with a rake. It is a sort of work that requires little art or trouble in its execution; but whether performed with the common or horse-rakes, it should always be done in an effectual manner. In the business of hay-making, clean raking not only affords a neatness in the appearance, but, over a great extent of surface, a considerable saving of hay. See **HAY-Making**.

In raking hay lands, where horses are employed, some degree of care is necessary in directing the work, and driving the animals, in order that no inconvenience of delay may be experienced, and that every part of the land may be gone over in the most regular manner. Small boys may serve to direct the horses by riding upon them, and some saving be made in that way.

In raking cut corn crops with horse-rakes, especially those of oats and barley, it is sometimes the best method to proceed in a cross direction of the ridges, drawing up the produce into long rows at suitable distances; the horses being driven by the men, who know the management of the handles of the rakes, by means of whip reins brought from the horses to the flits of the implements. It seldom happens that so good work can be made in going the lengthways of the lands, particularly where they are much rounded, and of a small size in breadth, as the tools will not fit well to their rounded form, unless where they are constructed in separate parts in their heads, so as to admit of motion by means of joints. In this mode of raking, the corn may sometimes be readily tied up into sheaves.

But in the raking of stubbles, it is more usual to pass in the direction of the ridges, though the contrary method is not unfrequently had recourse to. In those cases, as well as in the others, the straw grains or stubbles are always brought together into lines or rows, in order to be more readily taken up by the carts either bound or unbound.

In the raking of the roots of weeds together upon lands, it is constantly the best practice to perform the work in both directions; as, by such means, the whole of them may be laid hold of in a more complete and effectual manner than could otherwise be done. See **RAKE**.

RAKING, in *Gardening*, a necessary operation in the garden, to break the surface of the soil small, and render it fine for the reception of particular sorts of small seeds and plants, previous to sowing and planting, as well as to render

it neat and even to the eye. It is also employed in raking in seeds, as being an expeditious mode of covering them in. In all kinds of small seeds, or hardy plants, the ground being dug, &c. and the surface remaining rough after the spade, the seed is sown, and then raked in with an even hand, once or twice in a place, as a back and a fore stroke, or more as may be necessary.

And this operation is useful also among growing plants, that stand distant enough to admit the rake, particularly where the surface is inclinable to bind, or where numerous small weed-seeds appear, as it loosens the soil, and retards the growth of the weeds, and promotes the growth of the young plants. It is also good culture at particular seasons, to annoy slugs, especially in kitchen-gardens, to rake between the rows of small plants in autumn and winter, &c. The raking of the beds, borders, and other compartments of pleasure-grounds, now and then, smooth and even, likewise gives an air of culture and neatness to the whole.

It may be observed, that this sort of work should generally be performed in dry weather, and when the ground is also moderately dry; as when done in rainy weather, or when the ground is very moist and cloggy, the surface is apt to cake and bind hard. This should be well attended to in sowing seeds. Rough dug ground does not rake well, when it is become very dry at top, especially if it was dug wet, and suffered to lie till the clods have become very dry and hard; in which case it will not rake well, until mellowed or pulverized by a shower of rain. But common light garden ground generally rakes best when fresh dug, perhaps the same day, or day after at the farthest, before dried too much by the sun and wind, or rendered wet by rain, &c. The operation should, however, be performed when the ground is in such order as the clods will readily break and fall to pieces under the rake, without clogging much to it, or the mould become even without running into lumps.

RAKING of a Horse, is the drawing his ordure with the hand out of the fundament, when he is coltish, and cannot dung. In order to do this, the hand must be anointed with fallad-oil, or butter.

RAKING a Ship, is the act of cannonading a ship on the stern or head, so that the balls shall scour the whole length of her decks, which is one of the most dangerous incidents that can happen in a naval action, so much so, that the men are ordered to lie down at their quarters. This is frequently called raking fore and aft, being the same with what is called enfilading by engineers. See **ENFILADE**.

RAKING-Knees. See **KNEES**.

RAKING-Table, or *Raked Table*, among *Architects*, a member hollowed in the square of a pedestal, or elsewhere. See **CAVETTO**, and **SCOTIA**.

RAKOKIE, in *Geography*. See **RACH-KOKE**.

RAKONITZ, or **RAKOWNITZ**, a town of Bohemia, and capital of a circle of the same name, which is mountainous and covered with forests, but fertile in corn, and affording some excellent horses. It was made a royal town in 1588. It is celebrated for its beer, which is the principal article of its commerce; 22 miles W. of Prague. N. lat. $50^{\circ} 5'$. E. long. $13^{\circ} 57'$.

RAKORA, a town of European Turkey, in Bulgaria; 40 miles S.S.E. of Viddin.

RAKOW, or **RACOW**, a town of Austrian Poland, in the palatinate of Sandomirz, formerly populous; the Soci-nians had a college and printing-house here, but were expelled in 1643; 40 miles W. of Sandomirz. See **RACOW**.

RAKOWEENA, a harbour on the coast of Kamtchatka, in Awatka bay, three miles long, and one and a half

half broad, with water from thirteen to three fathoms, and a bar at its entrance: it runs at first in a south-east and afterwards in an easterly direction; three miles S. of St. Peter and St. Paul.

RAKSHA, in *Hindoo Mythology*, a species of malignant demon, of whom great use is made in their epic machinery and popular tales. They are of various shapes and colours, and supposed to be animated by the souls of bad men of earlier existence, receiving punishment in these forms as enemies to the gods, and obstructors of their beneficent intentions towards mankind. Another class of these evil genii comprehends those called Yaksha. Rakshasa and Yakshasa are the plurals, and Rakshini and Yakshini the feminine; for these evil doings are not confined to sex. Ravana, the giant king of Lanka, or Ceylon, who opposed Rama, aided by the gods in the invasion of his kingdom, is sometimes called the lord of Rakshasas. See RAVANA.

RAKULSKOI, in *Geography*, a town of Russia, in the province of Usting, on the Dwina; 20 miles N. of Krasnoborsk.

RALEGH, Sir WALTER, in *Biography*, a distinguished character in the reigns of queen Elizabeth and James I., was second son of a gentleman of an ancient family in Devonshire. Few names, says sir Walter's biographer, Mr. Cayley, vary so much in the manner of writing it. By sir Robert Naunton and lord Bacon it is written *Rawleigh*; in some old deeds the orthography is *Rale* or *Ralega*; while king James, Hooker, and other respectable writers, adopt the mode of spelling which is still common in this country, viz. *Raleigh*; but the original letters of sir Walter himself, wherever the signature is preserved, have *Ralegh*, and on that account we choose to adopt it in this work. Sir Walter, of whom we are treating, was born at a farm called Hayes, in that part of Devonshire that borders on the sea, in the year 1552. By his mother he was related to those famous knights, sir John, sir Humphrey, and sir Adrian Gilbert. After he had received the usual school education, he was sent to Oriel college, Oxford, where he distinguished himself by a proficiency in learning far beyond his age; but the active disposition and martial ardour with which he was endowed, soon put an end to his learned career. About the year 1569, he, in company with many young gentlemen of the best families in the country, went into France, as well to instruct themselves in the art of warfare, as to assist the Protestants in that kingdom, who were then grievously oppressed. In this school he was employed five or six years, but by what means he escaped the horrible massacre of Paris, and the provinces, on the famous St. Bartholomew's day, we have no knowledge. He returned to England in 1575, and it should seem he immediately became a resident in the Middle Temple, whence a commendatory poem of his, prefixed to a work of George Gascoigne's, is dated in 1576. That he was not a student in the law, at this time, he has himself declared, and he shortly after passed into the Netherlands, where he served some time against the Spaniards. In this, and other transactions of the same kind, he followed the fashion of the times. France and the Netherlands were in those days the schools of Mars; to which all were obliged to resort who meant to pursue the fortune of arms. Many young men returned to their native country ruined in their fortunes, their constitution, and morals; but Raleigh had made a good use of his time, gained a large stock of useful knowledge, and was so completely polished in his manner of address, that he was now considered as one of the best bred and most accomplished gentlemen in England.

On his return in 1578, he found his half-brother, sir Humphrey Gilbert, engaged in a design of making disco-

veries in North America, for which he had obtained a patent, and for the furtherance of which he had procured the assistance of many friends. Raleigh was delighted with the design, and embarked in it cordially. This project proved very unfortunate to the adventurers, but it gave young Raleigh an introduction to the sea service, in which he afterwards to much distinguished himself. From this unlucky adventure, Mr. Raleigh arrived safe in England in the spring of the year 1579, and very soon after he appears to have offered his services to the queen to go to Ireland, to the inhabitants of which, pope Gregory VIII. and the Spaniards had sent men, money, and other assistance, to enable them to take arms against the established government. He obtained a captain's commission, and served in Munster under the earl of Ormond. In this petty warfare he displayed so much good conduct, vigour, and courage, that he was afterwards made governor of Cork; and as a reward for his services, he received from the crown the grant of a considerable estate in Ireland. A misunderstanding with the lord-deputy Grey put a stop to his farther rise in the army; he returned to England, and was quickly introduced to the queen's notice, and by his own merits attained a large share in her favour. As he was forward to distinguish himself in all public services, so on the return of the duke of Anjou into the Netherlands, he was one of those who accompanied him out of England, by the express command of queen Elizabeth, and on his coming to England in 1582, he brought over the prince of Orange's letters to her majesty. Some months after this he resided at court, and was honoured with the favour and protection even of contending statesmen, who were proud of shewing the true judgment which they had of real merit, by becoming patrons to Raleigh. In 1583 he was concerned in his brother Gilbert's second attempt, and though he did not venture in person, yet he built a new ship, called the bark Raleigh, and furnished it completely for the voyage; "the unsuccessful end of which," says Campbell, "it seemed to predict, by its untimely return in less than a week to Plymouth, through a contagious distemper which seized on the ship's crew."

While at home Raleigh was not negligent of pushing his fortune as a courtier. He had a good person and address, made an elegant appearance, and put on that air of gallantry which was so meritorious in the eyes of Elizabeth. It is said, that he was once attending the queen in a walk, when she came to a spot, that by its mire obstructed her course; he immediately took off his rich cloak, and spread it on the ground for her to walk on. Pleased with this attention, it is observed, that the sacrifice of a cloak obtained for him many a good suit. The enterprising spirit of Raleigh was shewn in the year 1584, in a scheme which he formed of making discoveries and settlements in those parts of North America which had not been subjected to any European power. His interest at court, and his ability in stating and setting forth his plans to the best advantage, obtained for him an extensive patent for executing his purpose; and, in consequence, with the help of a society of his friends, he fitted out ships under the command of captains Amadas and Barlow, which sailed from Plymouth in that year, and took possession of an island near the mouth of Albemarle river, in what is now called North Carolina. From the terms of the patent, it appears, that the great object of these adventurers, as it was of all others in that reign, was the search after mines of the precious metals. Raleigh was not himself in this expedition: the ships returned in the autumn with some commodities which sold so well, that the company was encouraged to fit out a fleet of seven vessels for the following year, of which the command was given to sir

Richard

Richard Greenville, Raleigh's relation. During this voyage they took possession of that tract of country which has been so famous, by the name bestowed upon it by queen Elizabeth, and not given, as it has been generally supposed, by Raleigh, of Virginia. After expending a large sum in repeated attempts to repair the misfortunes that had happened to the newly established colony, he assigned over his patent to a company, reserving to himself only a portion of the expected gold and silver ore. This enterprise probably made England first acquainted with tobacco, and also conferred upon it the much greater benefit of introducing the culture of the potatoe, first practised on Raleigh's estate in Ireland.

About this time he was chosen knight of the shire for the county of Devon, and very soon after the queen conferred upon him the honour of knighthood, an honour which she did not render cheap by prostituting it. In the year 1585 he fitted out another fleet for Virginia, in which he had good success, his ships, in their return, taking a prize worth 50,000*l*. He was likewise concerned in captain Davis's undertaking for the discovery of the north-west passage, on which account a promontory in Davis's freights was called Mount Raleigh. For these public-spirited and expensive projects, the queen was pleased to make him some profitable grants; particularly two, the first giving him authority to license the retailers of wine throughout the kingdom, and the other of a feignory in Ireland, consisting of twelve thousand acres, which he planted at his own expence, and many years after sold to Richard Boyle, the first earl of Cork. In 1586 he was appointed seneschal of the duchies of Cornwall and Exeter, and lord-warden of the stannaries; and so high did he seem rising in the queen's favour, that the favourite minister, the earl of Leicester, took the alarm, and brought forward the earl of Essex as his competitor. But her majesty's partiality was fully justified; it was, in this instance, extended to a man, who at all times pursued whatever appeared to him conducive to the public good, how little soever it turned to his private advantage. "With justice, therefore," says Campbell, "was the wise queen Elizabeth liberal to such a man, who, whatever he received from her bounty with one hand, bestowed it immediately in acts glorious to the nation with the other." In the year preceding the attempt of the famous Spanish armada, sir Walter was captain in the queen's guard, and her lieutenant-general for Cornwall. In the latter capacity he was active in disciplining the militia of the county; and he was one of the council of war to whom the consideration of the best means of opposing the dangers of that momentous period was committed. When the armada appeared in the Channel, he was one of the gallant volunteers who nobly joined the English fleet with ships of their own, and had a share in the defeat of the enemy. In 1589 he was among those who accompanied the expelled king of Portugal in his attempt to reinstate himself. The queen shewed her continued approbation of his services, by making him gentleman of her privy-chamber, and augmenting the profits of his other places. This last was no small favour in Raleigh's estimation, for though in many respects of an elevated mind, fond of glory, splendid and liberal, he was likewise intent upon gain, and neglected no source of emolument which his court interest placed within his reach. He did not scruple, we are told by some of his biographers, though the fact is not noticed by Campbell and others, to take direct bribes for the exertion of his influence; and he is said to have received no less than ten thousand pounds for procuring a pardon for Mr. Littleton. See Biog. Brit. article *Littleton*.

On his return from his Portugal voyage he visited his Irish estates, and there either formed or renewed his acquaintance with the poet Spencer, who celebrates him under the title of the "Shepherd of the Ocean," and acknowledges the obligation of having first made him known to the queen. To his Fairy Queen he likewise prefixed a letter to Raleigh, explanatory of its plan and design. The patronage of literature was one of the best traits in the public characters of an age, in which mannefs was singularly mixed with heroism. The naval enterprizes of the reign of Elizabeth were for the most part predatory expeditions, set on foot by individuals for their private benefit, and encouraged, though but feebly aided, by the crown. In 1592 sir Walter Raleigh engaged in a considerable undertaking of this kind, with a view of attacking Panama, and intercepting the Spanish Plate fleet. He fitted out thirteen ships, by himself and his associates, which were joined by two of the queen's men of war, and he was appointed general of the whole fleet. Scarcely had he set sail when he was recalled by his sovereign; proceeding, however, to Cape Finisterré, he divided his fleet into two squadrons, with cruising orders, and then returned. One of the squadrons fell in with a rich carrack, the capture of which was the only instance of success which attended the expedition. His ardour for war was shewn by his support in parliament of a motion, that certain subsidies granted to the crown should be for the express purpose of carrying on a war offensive and defensive against Spain. To undermine his credit with the queen, Parsons, a Jesuit, published a libel against him, charging him with Atheism; the queen is said to have imbibed some prejudice against him on this account, but he incurred her heavy displeasure by an intrigue with one of her maids of honour, the daughter of sir Nicholas Throgmorton. The consequences of this amour brought a scandal upon the court of the virgin queen; and though he made the best reparation in his power, by marrying the lady, his offence was punished by an imprisonment in the Tower of some months, and a subsequent banishment from the queen's presence.

During his imprisonment he projected an expedition for the discovery of the empire of Guiana, which had already been visited by the Spaniards, and the extent and opulence of which had been the subject of many marvellous tales. Having obtained some preliminary information, from an old navigator whom he dispatched for the purpose, he embarked in person, in the month of February 1595, with a squadron of ships fitted out at a great expence, and sailed to the island of Trinidad, where he made himself master of the town of St. Joseph; he then proceeded up the great river Oroonoko, but was obliged by the heat of the weather, and the difficulties of the navigation, to return, with doing nothing more than merely taking possession of the country in her majesty's name. Unwilling to return without appearing to have done something, he published a work, entitled "Discovery of the large, rich, and beautiful Empire of Guiana;" which was evidently the result of a fertile imagination rather than of real observation, and which Hume stigmatizes as a production "full of the grossest and most palpable lies that were attempted to be imposed on the credulity of mankind."

Sir Walter had so far regained the good opinion of the queen, that he had a naval command in the expedition against Cadiz, in 1596, under the earl of Essex and lord Effingham. In the attack he was one of the leaders of the van, and by his valour and prudence contributed a full share to the success of the glorious action. In the following year he sailed as rear-admiral in the expedition of which Essex was commander-in-chief, and the purpose of which was to intercept the Spanish West India fleet. Arriving first with

his squadron at Fayal, after waiting some time for Essex, he thought it expedient to make an attack on the place by himself, which proved successful. The commander-in-chief was mortified with this action, thinking it was designed to rob him of the glory due to him, and would have cashiered Raleigh, if lord Thomas Howard had not interposed his services to effect an apparent reconciliation. "On their return lord Essex published some remarks upon what had happened in the course of the voyage, in which he questioned every body's conduct but his own. "The queen, however," says Campbell, "taking time to inform herself, made a right judgment of the whole affair; in consequence of which she paid a due respect to every man's merit, and greater to none than to that of sir Walter Raleigh."

During the remainder of this reign Raleigh chiefly appears as a member of parliament, and as an assertor of the privileges and interests of the people in the west, over whom his authority extended. That he was completely reflected to the favour of his royal mistress is evident from the circumstance, that in 1661 he attended her in a progress through part of the kingdom. He was likewise appointed by her to receive the duke of Biron on his arrival as ambassador from France, and conferred with him on the subject of his mission. In the queen's last parliament sir Walter was a very active member, and distinguished himself upon all occasions, by opposing such bills as, under colour of deep policy, were contrived for the oppression of the middle and lower ranks of society. He witnessed the ruin of his great antagonist the earl of Essex, whose execution he indelicately urged upon the minister Cecil; and he was even an eye-witness of the deed. Campbell, endeavouring to justify him in every thing, is evidently, in some instances, a panegyrist rather than a faithful historian. The decease of the queen, which soon followed the execution of her former favourite lord Essex, and which was probably hastened by it, gave a final, and to Raleigh a very unexpected, blow to his own prosperity.

When James came to the crown it was a sort of contest between sir Walter Raleigh and sir Robert Cecil, who should obtain the confidence of his majesty; the latter, however, was admitted to the royal councils, to the exclusion of sir Walter Raleigh. In truth, James had a prepossession against Raleigh, as having been the enemy of Essex, and still more, as having, with some others, entertained a design of forcing the king to agree to certain limitations with respect to the number of his countrymen whom he was to bring with him. Sir Walter's martial and enterprising spirit was also obnoxious to a prince of a pacific disposition. He was, therefore, received, barely with civility, a circumstance which preyed upon his high spirit, and was probably the means of throwing him into the party of the discontented. A conspiracy, for the purpose of placing upon the throne lady Arabella Stuart, was at this time formed, in which Raleigh in some measure participated. He was apprehended, and brought to trial on a charge of high treason; but, says the historian, his condemnation, upon the evidence produced, was one of the most disgraceful instances on record, of the base subservience of an English jury to the vindictive wishes of a court. His only accuser was lord Cobham, a man of bad character, and one who was deeply implicated in the plot, to whose proposals he had given ear, but probably without entering into, or even approving them. In his defence he displayed so much eloquence, temper, and force of argument, that some, who had been highly prejudiced against him, were brought to regard him as an innocent victim, and, it should seem, from the testimony of contemporary historians, that all parties were ashamed of the injustice of his condemnation.

It is said that even Coke, the attorney-general, who treated Raleigh on his trial with all the abuse that belonged to his character, and was thought authorized by his office, expressed surprize at the sentence, and declared that he had charged him with no more than misprision of treason. Three were executed for this plot, two were pardoned, and Raleigh was only reprieved and committed to the Tower. His wife, at her own earnest solicitation, was permitted to become his fellow-prisoner, and his youngest son was born in the Tower.

In Mr. Cayley's life of sir Walter Raleigh, published in London in 1806, we have a curious letter of lord Cecil, then secretary of state, to sir Thomas Parry, the English ambassador in France, in which he gives an account of the conspiracy just referred to, and of the motives which led the different persons to take a part in it. Sir Walter was indicted for conspiring to deprive the king of his government, to raise up sedition within the realm, to alter the religion and bring in the Roman superstition, and to procure foreign enemies to invade the kingdom. The principal overt act laid in the indictment was, that sir Walter had a conference with lord Cobham, as to the best means of advancing Arabella Stuart to the crown and throne of this kingdom, and that they should apply to the king of Spain to procure his assistance in this cause. Sir Walter made an able stand in his trial against the legality of conviction upon the evidence of a single witness, but the judge, rendered infamous by his conduct on the trial, over-ruled the objections.

The active mind of sir Walter Raleigh was now left to exert itself within the walls of a prison, and its employment conducted more to his honour than his liberty perhaps would have done. Here he composed the greater part of his works, especially his "History of the World." Prince Henry, a youth of most amiable qualities, and as unlike his father as possible, contracted a generous admiration for the splendid talents of Raleigh, and cheered him in his solitary confinement by his friendship and correspondence. "No king," said the royal youth, "but my father would keep such a bird in a cage." Henry, however, died, and with him the hopes of deliverance vanished from the mind of the state prisoner. At length, however, after twelve years' confinement, sir Walter obtained his liberation, but probably not without the use of bribes, applied to the new favourite Villiers. For the purpose of repairing his fortunes, he planned a new expedition to Guiana, and his report of a rich gold mine existing in that country was a sufficient inducement for a number of adventurers to engage in the scheme. He obtained a patent under the great seal from the king, for making a settlement in Guiana. James, however, in order to retain his hold upon him, did not grant him a pardon of the treasons of which he had been convicted. There is no doubt but sir Walter might have purchased a pardon, and, at one time, had thoughts of doing so. He even consulted sir Francis Bacon, whether it would not be advisable for him to give a round sum of money for a pardon in common form; to which the learned lawyer answered; "Sir, the knee timber of your voyage is money; spare your purse in this particular, for, upon my life, you have sufficient pardon for all that is past already, the king having under his broad seal made you admiral of your fleet, and given you power of the martial law over your officers and soldiers." Raleigh having employed all his resources in fitting out the expedition, sailed for Guiana with twelve armed vessels in July 1617. He had not set sail long before he was obliged to put into the harbour of Cork, by stress of weather, where he remained till the 19th of August. In November he arrived at Guiana,

Guiana, where he was received with the utmost joy by the Indians, who not only rendered him all the service in their power, but endeavoured to persuade him to end all his labours there, and take upon himself the sovereignty of the country, which, however, he steadily refused. A violent and long continued sickness prevented him from undertaking the discovery of the mine in person. This important affair he entrusted to one of his captains, Keymis: the scheme, however, proved abortive, the Spaniards having been before hand with him in the search of gold. Hume, for the purpose of exculpating James, endeavours to shew that the real intention of sir Walter Raleigh was to plunder the Spanish settlements, and neither to colonize, nor to work the mines. He allumes that Raleigh was a wilful deceiver in the expectations he had raised of vast subterraneous riches; but considering his character, it is surely more reasonable to believe that he was carried away by some vague ideas of this kind, and Hume admits that the Spaniards were at the very time working some mines. It will be readily admitted, that James did not imagine he was giving Raleigh a commission of hostilities against Spain, yet he must have known that the exclusive claims of that crown in South America rendered every interference with its dominion hostile in its eyes. The fact seems to be, that the expedition was undertaken with an intention to make the most of it, by any means within the power of the armament, and that the commander trusted to its success for justification before a court where bribery to favourites was omnipotent.

In this expedition Raleigh's eldest son lost his life, of which, and of the unfortunate issue of Keymis's undertaking, he reproached his captain very severely, who, without hesitation, put an end to his own life. Raleigh, with a heavy heart, fled homewards. In July 1618 he arrived at Plymouth, and in his journey to London he was arrested, and carried back to Plymouth. Twice he attempted to escape, but was secured and committed a prisoner to the Tower. James was exasperated at the injury which had been inflicted on Spain, a power then in amity with England, and which had been complained of by the Spanish court in very strong terms. He was, moreover, about to enter into a more intimate connection with that court, and therefore, without hesitation, determined to sacrifice Raleigh to its resentment. Though his death had been determined on, it was difficult to take away his life. His conduct in the late expedition, though the want of success had rendered it criminal in the eyes of the court, was far from being so in the sight of the nation; and though judges might have been found who would pronounce it treason, yet even in those days it was not easy to find a jury who would, without evidence, have found him guilty. The commissioners therefore, who had been appointed to enquire into the matter, and who had frequently examined him, finally reported, that no ground of legal judgment could be drawn from what had passed in the expedition. Upon this, it was resolved to call him down to judgment upon his former sentence, which, says Campbell, was done, with all the circumstances of iniquity and brutality that can well be conceived. Being brought before the court of king's bench, his plea of an implied pardon, by his having acted under the king's commission since sentence had been pronounced, was over-ruled, and he was not permitted to enter into a vindication of his conduct in the late voyage. Execution was accordingly awarded, and the king's warrant for it produced, which had been signed and sealed before-hand.

"That this judgment was illegal," observes Dr. Campbell, "and that sir Walter was really murdered, has often been said, and, I believe, seldom doubted; but I think it has not been made so plain as it might be, and, therefore, in

respect to his memory, I will attempt it, by shewing that the judgment was absolutely illegal, as well as manifestly iniquitous.

"It is a maxim in our law that the king can do no wrong; and most certain it is, that no king can do legal wrong, that is to say, can employ the law to unjust purposes. Sir Walter Raleigh, after his conviction, was dead in law, and, therefore, if king James's commission to him had not the virtue of a pardon, what was it? Did it empower a dead man to act, and not only to act, but to have a power over the lives and estates of the living? It either conveyed authority, or it did not. If it did convey authority, then sir Walter was capable of receiving it; that is, he was no longer dead in law: or, in other words, he was pardoned. If it conveyed no authority, then this was an act of legal wrong. I cannot help the blunder; the absurdity is in the thing, and not in my expression. A commission under the privy seal, if not under the great seal, granted by the king, with the advice of his council, to a dead man; or, to put it otherwise, a lawful commission given to a man dead in law, is nonsense not to be endured; and, therefore, to avoid this, we must conceive, as sir Francis Bacon, and every other lawyer did, that the commission included, or rather conveyed, a pardon. Indeed, the same thing may be made out in much fewer words. Grace is not so strong a mark of royal favour as trust; and, therefore, where the latter appears, the law ought, and, indeed, does, presume the former. This judgment, therefore, did not only murder sir Walter Raleigh, but, in this instance, subverted the constitution, and ought to be looked upon, not only as an act of the basest prostitution, but as the most flagrant violation of justice that ever was committed."

The sentence of death was pronounced on him one day, and put in execution on the following, Oct. 29, 1618, in Old Palace Yard. His behaviour on the scaffold was calm and manly. He addressed the people at some length: he said he never feared death, and much less at that time; that as to the manner of it, though to others it might seem grievous, yet for himself, he had rather die in this way than in a burning fever. He desired to see the axe, and feeling the edge of it, said to the sheriff, "this is a sharp medicine, but a sure remedy for all evils." Being asked which way he chose to place himself on the block, he replied, "so the heart be right, it is no matter which way the head lies," and giving the signal, he received the stroke with the most perfect composure. Such was the end of the illustrious sir Walter Raleigh, in the 66th year of his age, by a sentence which was regarded as one of the most dishonourable measures of an odious administration. The panegyric upon his character by Dr. Campbell is much too highly coloured: sir Walter Raleigh was not faultless, though in extent of capacity and vigour of mind he had few equals in an age that abounded with great men. His imprisonment was the occasion of his obtaining a high reputation as an author. His writings were on various topics, and are classed as poetical, geographical, political, philosophical, and historical. They are now but little known. His "History of the World," though not much read, is regarded with respect, as one of the best specimens of the English language of that time: the style is pure, nervous, and without pedantry. It is the style of a man of business as well as of a scholar. It has been many times reprinted, but the best edition is that of Oldys, in 1736. He brought down his history no farther than the overthrow of the Macedonian empire. Of his miscellaneous works, a collection in two volumes 8vo. was printed in 1748. Biog. Brit. Hume. Campbell. Cayley.

RALEIGH, or RAYLEIGH, in *Geography*, a market-town

and parish in the hundred of Rochford, and county of Essex, England, is situated at the distance of 14 miles S.E. by S. from Chelmsford, and 34 miles E. by N. from London. This place appears to have been anciently of considerable note. It was the head of the barony of Swene, and had a castle adjoining to it, of which some fragments and earth-works still remain. These consist of a mount, with an oval-shaped base, surrounded by a double ditch and rampart, and several outworks, particularly on the east side. The summit of the mount is divided; the western division being of a circular form, and 100 feet high; and the eastern one of an oval form, and lower: the principal ditch varies in width from 36 to 50 feet, and the interior vallum is 50 feet high. The church here is an ancient edifice, and contains an old tomb, greatly mutilated, but displaying the remains of very beautiful workmanship in the pointed style. The person whose memory it was intended to preserve is now unknown; the upper part, to which the inscription was probably affixed, being totally destroyed. The market at Raleigh is held on Saturday, weekly; and there is an annual fair on Trinity Monday. Hearne, in his edition of Leland's Itinerary (vol. iii. p. 8.), informs us that a custom-court is kept here, yearly, the Wednesday next after Michael's day. "The court," says that author, "is kept in the night, and without light, but as the squire gives, at a little hill without the town, called the King's hill, where the steward writes only with coales, and not with ink; and many men and manners of great worth hold of the same; and do suite unto this strange court, where the steward calls them with as low a voice as possible he may; giving no notice when he goes to the hill to keep the same court; and he that attends not is deeply amerced, if the steward will. 'Tis commonly called *Lawless-Court*." Weever, in his "Funeral Monuments," adds, respecting this custom, that he was informed, "that this vile attendance was imposed at the first upon certain tenants of divers manors hereabouts, for conspiring in this place, at such an unreasonable time, to raise a commotion." According to the parliamentary returns of 1811, Raleigh parish contains 162 houses, and 1131 inhabitants. Beauties of England and Wales, vol. v. By E. W. Brayley and John Britton, F.S.A. 1810.

RALEIGH, a township of Essex county, in Upper Canada, W. of Harwich, bounded on the N. by the Thames, and S. by lake Erie.

RALEIGH, a town of America, in Wake county, North Carolina, the present seat of government, about ten miles from Wake court-house. The general assembly of the state in December 1791, appropriated 10,000*l.* towards erecting public buildings, and named it after the celebrated sir Walter Raleigh, under whose direction the first settlement in North America was made at Roanoke isle and in Albemarle sound. The state-house is a large handsome building, and cost 6000*l.* The plan of the town is regular; the streets intersecting each other at right angles. It is, however, subject to the disadvantage of being remote from navigation; 61 miles N.E. of Fayetteville, 147 from Petersburg in Virginia, and 448 S.W. of Philadelphia.

RALEMO, a river of Chili, which runs into the Pacific ocean, S. lat. 37° 55'.

RALENDORF, a town of the duchy of Carinthia; 12 miles S. of Saxenburg.

RALESTEDÉ, a town of the duchy of Holstein; 8 miles E. of Hamburg.

RALICOTTA, a town of Hindoostan, in Vishapour; 31 miles N. of Anamagar.

RALENTANDO, Ital., a musical term of late invention, for relaxing the measure at particular parts of a

composition, which, when done by a great master, manifests feeling and intelligence; but when attempted by mean performers, it has no other effect upon an audience than that of breaking time: and we think that this refinement is often abused. It has been chiefly practised in France, and favours of affectation, and that *overcharged tenderness* which renders the national *airs tendres* so disagreeable, or so ridiculous, to the natives of all other countries.

RAILLUS, the Rail, in Ornithology, a genus of birds of the order Gallæ: the generic character is, that the bill is thickish at the base, attenuated on the back towards the tip, compressed, a little incurved, pointed; the tongue is rough at the tip; the body is compressed; the tail is short; the feet have four cleft toes. There are seventeen

Species.

* CREX; land rail, crake, corn crake, daker hen, &c. Of this species the wings are of a rusty red; the bill and legs of a brownish-ash; the irides are of a hazel colour; the feathers of the body are of a reddish-brown; the upper ones are black in the middle; the chin is very pale, and the belly is of a whitish-yellow. It is about nine or ten inches long, and inhabits the sedge parts of Europe and Asia. From the circumstance of its appearing at the same time with the quail, and frequenting the same places, it has been denominated the king of the quails. Its well-known cry is first heard as soon as the grass becomes long enough to shelter it, and continues till the grass is cut. The bird, however, is seldom seen, as it skulks in the thickest parts of the herbage, and runs so nimbly through it, winding and doubling in every direction, that it is difficult to come near it. When it is hard pushed by the dogs, it sometimes stops short and squats down, by which means its too eager pursuer overshoots the spot and loses the trace. It seldom springs but when driven to extremities, and generally flies with its legs hanging down, but never to a great distance. As soon as it alights, it runs off, and before the fowler has reached the spot, the bird is at a considerable distance. It emigrates, appearing with us about the latter end of April, and departing in October. On its first appearance, and till the female begins to sit, the male is frequently heard to make a singular kind of noise, much resembling that of a comb when the finger is drawn along the teeth of it, and which has been used as a decoy. When they first arrive, they are very lean, but before their departure, they become excessively fat, and are much sought after for the delicacy of their flesh. They lay from twelve to sixteen eggs in the grass, of a dirty whitish colour, with a few yellow spots: the flesh is excellent. There are two varieties, thus described: 1. Rufous brown, beneath paler; wings and tail deeper; the chin and vent are white; the legs are dusky red. This is found in the island of Jamaica. The bill is larger and black. 2. Reddish-grey beneath, and wing-coverts rusty brown. This species inhabits China; the legs are of a dusky colour.

AQUATICUS; Water Rail. Wings grey spotted with brown; flanks spotted with white; bill orange beneath, but black and reddish at the base; the irides are red; the feathers of the upper part of the body are of an olive-brown, and black in the middle; the lower ones are cinereous; those of the lower part of the belly and vent are edged with rufous; quill-feathers dusk; the lower tail-coverts are white; the tail-feathers are short and black; the two middle ones at the tip, and the others, are edged with ferruginous; the legs are of a dusky red. It is about twelve inches long, but does not weigh more than four ounces. It is found in the watery places in Europe and Asia. It is sometimes, but not in

any

RALLUS.

any great numbers, met with in various parts of Great Britain, in low situations, about water courses and rivulets, where it seeks shelter among sedge, rushes, and reeds, and is seldom put to flight, depending on its legs for safety. When roused it flies only to small distances, and in a heavy and very awkward manner, with its legs hanging down. It runs nimbly, and frequently flutters up its tail. The nest is made of sedge and coarse grass, among the thickest aquatic plants, or in willow beds. The female lays six or more eggs, rather larger than those of a blackbird, of a pure white colour. This bird continues with us all the year, and by many it is erroneously believed to be the land rail metamorphosed in the autumn; but the different bills which the two birds have constitute an essential distinction.

***PORZANA**; spotted gallinule, or spotted water hen. This species has the two middle tail-feathers edged with white; the bill and legs are of a pale olive. It inhabits Europe and North America, and is generally found on the sides of small streams, hiding itself among the bushes; it is nine inches long. This bird is described as having a greenish-yellow bill; its irides are hazel, and head brown, spotted with black. The line over the eyes is of a pale grey; the neck above and flanks are of a brown-ash, with small white spots; the back and wing-coverts are olive, with black stripes, and near the edges of the feathers with white spots, the greater with white stripes and lines; the cheeks, chin, and throat, are of a pale grey, with brown spots; the breast is brown, with white spots; the belly is varied with cinereous and white; the vent is of an ochre-yellow. This bird is extremely timid and sequestered, and is but seldom seen in Great Britain, eluding observation by its perpetual vigilance and lurking habits. Its nest is formed, with singular care, of matted rushes, and materials which will float on the water, on which it remains tied, by some filaments, to the stalks of reeds, by which it is prevented from being carried away by the tide or current. The bird is in great esteem for the table.

CREPITANS; Clapper Rallus. Bill and legs brown; body above olive, the feathers ashy at the edges; chin white, throat and breast yellowish-brown. This species inhabits New York, and is from fourteen to sixteen inches long.

FUSCUS; Brown Rallus. This is brown, as its specific name imports; its vent is waved with white; the legs are yellow. It inhabits the Philippine isles, and is seven inches long. The body beneath is light chestnut, on the belly it is inclining to grey; the tail is barred with white and black.

STRIATUS; Streaked Rallus. Blackish, waved with white; chin reddish. The bill of this species is of a horn colour; the crown is varied with dusky and bay; the nape is bay; neck, back, shoulders, and rump, brown, with whitish spots; the wing-coverts are marked with a few transverse whitish streaks; the chin is of a reddish-white; the cheeks, throat, breast, and upper part of the belly, cinereous, with a tinge of olive; the lower part is barred with dusky and white; quill-feathers brown, the outer bands reddish-white, the inner are white; the tail is brown with white lines; the legs are of a greyish-brown. It inhabits the Philippine islands, is eight inches long, and is probably a variety of the philippensis.

TORQUATUS; Banded Rallus. Brown, beneath waved with white; it has a white line below the eyes. This also is found in the Philippine isles, and is twelve inches long. The bill and legs are grey-brown; cheeks and chin black. The body beneath is transversely streaked with black and white; the collar is of a bay colour; the quill-feathers on the outer

edge paler; bands within on the first three white, the six next reddish-bay.

PHILIPPENSIS; Philippine Rallus. The specific character of this bird is brown, but beneath it is barred with grey; the eye-brows are white, and the neck beneath has a reddish cast. There are three other varieties, thus described: 1. Red-brown, spotted and streaked with black and white; head chestnut; body beneath and eye-brows cinereous; this, notwithstanding its name, is found at Otaheite. 2. Brown, spotted and streaked with white, beneath white; eye-brows grey; the tail is barred with brown and white: this inhabits Tongataboo. 3. Above brown, beneath ashy; back and wings lined with white spots; the belly beneath is white, with blackish bars. This is about eleven inches long, and is found in the Philippine islands.

ECAUDATUS; Tailless Rallus. Olive; beneath blueish; body transversely waved with black; eye-brows white. It inhabits Otaheite. The bill is blackish, and the upper part of the head is of a pale brown; the orbits are black; over the eyes, on each side the head, it has a broad white line; the body above is of a deep glossy olive, with a tinge of olive on the shoulders; the vent is of a pale yellow; the tail is so short as to be scarcely perceptible; the coverts are of a pale blue.

CAROLINUS; Sorec. This bird is brown; the frontlet is black; the breast is of a lead colour; the bill is yellow; the legs are greenish. It inhabits Virginia, and is from seven to eight inches long: this is a capital bird for the table. The irides of this bird are red; the crown and body above are brown, marked with black spots; the face and chin are black; but the rest of the neck, temples, and breast, are of a blueish-ash; the belly and outer edge of the wings are white; the wings and tail are brown.

PHENICULUS; Red-tailed Rallus. This species is black but beneath it is white; the bill and legs are greenish; the front is naked and of a flesh colour; the vent and tail of a rusty red. It is found in the island of Ceylon, and is about nine inches long. The bill and legs are tinged with red; the crown and cheeks are pure white; the quill-feathers are spotted with blue. There are two varieties. 1. Above cinereous, beneath white; the belly and vent are red. This is an inhabitant of China, and is fifteen inches long. 2. The front of this is white; the vent is red, and the legs are yellow. It is found in Madagascar, and is longer than the last.

VIRGINIANUS; Virginian Rallus. Brown, without spots; the bill and legs are brown. It inhabits Virginia, and is probably a variety of the *R. aquaticus*.

FERRUGINEUS; Red-breasted Rallus. This bird is dusky above, and cinereous beneath; the neck and breast are ferruginous; the bill is pale, and the legs yellow. It is nine inches long; the eye-brows are pale, and the flanks are marked with transverse, narrow, white lines.

CAPENSIS; Cape Rallus. This species is of a ferruginous colour; but the lower part of the breast, belly, vent, wings, and tail, are waved with black and white; the bill is black, and the legs are of a blood-red. It inhabits the Cape of Good Hope and Ceylon, and is of the size of the *R. crex*. The two middle tail-feathers are ferruginous.

CERULEUS; Blue-necked Rallus. This is of a bay colour above, but blueish beneath; the bill and legs are red; the vent is white, and the belly is marked with transverse black streaks. It inhabits the Cape of Good Hope; it is seven and a half inches long.

ZEYLANICUS; Ceylon Rallus. The head of this bird is dusky; the body above is ferruginous, beneath it is reddish, waved with brown; the first quill-feathers are black; the

bill and legs are red. It is found, as its name imports, at Ceylon; it is larger than the *R. aquaticus*, and has a long tail.

AUSTRALIS; *Troglodyte Rallus*. Rusty ash; wings and tail deep brown; the feathers are barred with black. It inhabits New Zealand, and is seventeen inches long. The bill and legs are yellowish; the body above is of a rusty brown, beneath rusty ash; quill and tail-feathers are waved with black.

PACIFICUS; *Pacific Rallus*. Black, speckled with white; wings barred; body beneath whitish; the head is brown, the breast is of a blueish-ash. It is found in Otaheite, and the neighbouring isles. Bill red, the legs are of a flesh colour; the chin and eye-brows are white; the nape of the neck is rusty.

TABUENSIS; *Tabuan Rallus*. Brownish-black; beneath it is of a dusky colour; the bill is black, and the legs are bay. A variety has its vent streaked with black and white; the legs are red. It inhabits the South-sea islands, and is six inches and a half long. The eye-lids and irides are red.

NIGER; *Black Rallus*. Black; bill red at the base, brown at the tip; the legs are brown or red. This is an African bird, and is nine inches long.

SANDWICENSIS; *Sandwich Rallus*. This is of a pale ferruginous colour; but the bill is of a dusky ash; the legs are of a dull flesh colour. A variety has a yellowish bill and legs. It inhabits the Sandwich islands; and another variety is very small, and found in the Tanna isles.

TAITIENSIS; *Otaheite Rallus*. Cinereous; body above red-brown; the bill, rounded tail, and claws, are black. This inhabits Otaheite and the Friendly isles, and is about six inches long. The quill-feathers are dusky and edged with white; the legs are yellow.

OBSCURUS; *Dusky Rallus*. This is brown streaked with black, beneath it is of a rusty brown; the bill is black, and the legs are of a red-brown. It inhabits the Sandwich islands, and is six inches long; the edge of the mandibles is yellowish.

LONGIROSTRIS; *Long-billed Rallus*. The upper part of this species is cinereous, spotted with brown, beneath it is rusty white; the flanks are transversely waved with white, the bill is long and of a ferruginous colour. It inhabits Cayenne, and is from nine to twelve inches long. The bill is tipped with brown; the legs are yellowish, and the chin whitish.

VARIEGATUS; *Variegated Rallus*. This bird is streaked and spotted with white and black; the hind-head is dusky; the bill is yellowish; the chin is white; and the legs are yellow. It inhabits Cayenne, and is eleven inches long. The wings are brown, the coverts are spotted with white; some of the middle tail-feathers are edged with white.

CAYENNENSIS; *Cayenne Rallus*. The crown of this bird is rufous; the body above is of an olive-brown; beneath it is rufous; the ocular band is blackish; the quill-feathers are black; the bill is brown, and the legs bay. There is a variety having its crown bay; chin and vent reddish-white. It inhabits Cayenne and Guiana; it is eight inches long: in the evening it is noisy and gregarious, by day it is solitary; it builds in the forked branch of a shrub, near the ground. The vent is pale.

JAMAICENSIS; *Jamaica Rallus*. Above reddish-brown with black streaks; the bill and chin are black; the throat and breast are of a blueish-ash; the belly is marked with white and brown lines. It, as its name imports, inhabits Jamaica, and is six inches long. The bill is reddish at the base; wing-coverts brown, spotted with white; the quill-feathers are of a reddish-brown, with black lines, the secondaries

and tail-feathers are spotted with white, and the legs brown.

MINUTUS; the *Little Rallus*. This is brown, but beneath it is yellowish; eye-brows, streaks on the back, and spots on the wing-coverts, white; tail barred black and white. A variety has the middle of the neck above rufous; the belly and vent are waved with black and white. It inhabits Cayenne and Jamaica, and is five inches long. The bill is brown; the wing-coverts are black; the chin is whitish, and the legs are yellow.

PUSILLUS; *Dwarf Rallus*. Striped with ferruginous and black; the body beneath is blackish, with narrow white bands; the throat and breast are blueish. This is found near salt lakes of Dauria, and is of the size of a lark. The face, neck beneath, and middle of the breast longitudinally, are blueish; the middle of the chin is whitish; the longitudinal band through the eyes of a pale rusty colour; the back is scattered with white longitudinal lines; the legs are greenish.

BARBARICUS; *Barbary Rallus*. This is of a ferruginous colour; the bill is black; the wings are spotted with white; the rump is streaked above with white and black, and beneath with white; the legs are of a dusky brown. This, as its name imports, is an inhabitant of Barbary, and is the size of a plover.

DUBIUS; *Doubtful Rallus*. Striped with brown and ferruginous; the belly is white; the flanks are barred with brown and rusty ash; the first quill-feathers without are longitudinally white. It is the size of the common gallinule. The face is of a pale rusty colour; the chin is of a dirty white, surrounded with a broad brown collar; the sides are brown; the bill and legs greenish-black.

RALLYING, in *War*, the reassembling, or calling together of troops, broken, routed, and put to flight.

RALPH, JAMES, in *Biography*, a miscellaneous writer, descended probably from mean parentage, was the intimate friend of Dr. Franklin, who speaks of him as ingenious and shrewd, genteel in his address, and extremely eloquent. Franklin knew him in America, and though he does not mention what Ralph's situation then was, yet as he wrote a fine hand, and was well versed in accounts, it is imagined he was a schoolmaster. In 1725 Ralph accompanied Franklin to England, with a resolution of not returning to America, where he left his wife, with whom, and with whose family, he had lived on ill terms. In London he was, for a considerable time, supported by his friend Franklin, till their intimacy was dissolved, when Ralph considered the quarrel as a complete discharge of the debt which he owed his benefactor. Ralph changed his name to that of Franklin, which he thought necessary, having formed a new female connection, and settled as a schoolmaster in a village in Berkshire. From this time there is no regular narrative of his life, which was probably passed as a hired party writer. He is spoken of with much contempt in the *Dunciad*, as the author of a poem called *Night*:—

“Silence, ye wolves! while Ralph to Cynthia howls,
And makes night hideous—Answer him, ye owls.”

In a note, it is said he wrote a swearing piece, entitled “*Sawney*,” very abusive of Swift, Gay, and Pope; that he panegyriced his own works in the journals, was wholly illiterate, wrote plays, and was employed in a political newspaper. The satire of Pope must be taken with much limitation, it being inspired by party motives: Ralph having recommended himself to persons in power at the beginning of George II.'s reign, would for that reason be obnoxious to Pope and his friends. He became an able

writer in prose, and was author of many political pamphlets, which were much applauded in their time; but his chief work was "The History of England during the Reigns of William, Anne, and George I., with an introductory Review of the Reigns of the Brothers Charles II. and James II., in which are to be found the Seeds of the Revolution. By a Lover of Truth and Liberty," 2 vols. fol. 1774—6. This work obtained the plaudits of Mr. Fox, who, in his posthumous historical fragment, speaks of the author as an historian of great acuteness as well as diligence. The last publication of this author was entitled "The Case of Authors by Profession or Trade, stated with regard to Bookfellers, the Stage, and the Public," which is said to contain much good sense and lively satire. Mr. Ralph died at Cliffrick, in the year 1762. Gen. Biog.

RAM, in *Geography*, a town of European Turkey, in Servia, on the S. side of the Danube; 10 miles E. of Paf-farowitz.

RAM, in *Agriculture*, the male of the sheep kind. It may be observed, that the rams of different breeds of sheep vary greatly in their forms, wools, and fleeces, and other properties; but the following description by that excellent stock-farmer, Mr. Culley, deserves the attention of the breeder and grazier. According to him, his head should be fine and small, his nostrils wide and expanded, his eyes prominent, and rather bold or daring, ears thin, his collar full from his breast and shoulders, but tapering gradually all the way to where the neck and head join, which should be very fine and graceful, being perfectly free from any coarse leather hanging down; the shoulders broad and full, which must at the same time join so easy to the collar forward, and chine backward, as to leave not the least hollow in either place; the mutton upon his arm or fore-thigh must come quite to the knee; his legs upright, with a clean fine bone, being equally clear from superfluous skin and coarse hairy wool from the knee and hough downwards: the breast broad and well forward, which will keep his fore-legs at a proper wideness; his girth or chest full and deep, and instead of a hollow behind the shoulders, that part by some called the fore-flank should be quite full; the back and loins broad, flat, and straight, from which the ribs must rise with a fine circular arch; his belly straight; the quarters long and full, with the mutton quite down to the hough, which should neither stand in nor out; his twist, or junction of the inside of the thighs, deep, wide, and full, which, with the broad breast, will keep his fore-legs open and upright; the whole body covered with a thin pelt, and that with fine, bright, soft wool. It is observed, that the nearer any breed of sheep comes up to the above description, the nearer they approach towards excellence of form.

But though this is a very correct, appropriate, and admirable description of a finely-formed ram, objections have been made by some to a few of the properties which are laid down. Width and expansion of the nostrils in sheep, it is supposed, are liable to cause the lower parts of the noses to be too thick and large; while in naturally good and improved forms, the lower parts of the noses and mouths are for the most part small. Nor is the prominent and bold daring eye held in more estimation, as it is thought not to shew a good disposition; but, on the contrary, to display too much quickness and activity, or wildness of nature in the animal. Opinions, however, differ much on this point among sheep-farmers; and a lively quick eye is almost always considered as favourable to a good disposition.

Rams naturally possess more boldness and courage than either wethers or ewes; and they are very apt, unless

great care is taken, to acquire mischievous habits of attacking persons or animals that may by accident approach them.

In some sheep-districts the breeders are greatly in favour of large rams, but in others those of a smaller size are preferred; the choice of the size of the rams should, however, in every instance, be regulated by the nature and abundance of the keep, or the quality of the lands, as it is utterly impossible that the inferior sorts of pastures can keep sheep-flock of the large size, as in those of the better kinds; and it would be highly disadvantageous in the best rich sorts to have a small-sized flock when they could support a large one in an equally perfect manner. Middle-sized rams are, upon the whole, the most suitable and proper for lands in general, and for all the purposes of the breeder.

The growth and constitutions of young rams should never be suffered to be endangered by their having too great a number of ewes, as is too frequently the practice with sheep-breeders.

It is a very improper custom, but one which prevails with the graziers in some sheep-districts, to keep all their rams, perhaps to the amount of from twenty to fifty or more of all kinds, in one field or pasture; as their contentions are often so violent, especially about the riding time, as to cause the loss of one or two rams to each in all such cases. This practice is the most common in the sheep-districts towards the southern part of the island, being seldom met with in those of the midland or more northern parts. It ought to be every where done away with.

The old rams are now almost always got quit of by being fattened as rams, and sold at the neighbouring markets, or to butchers, at a very inferior price, there being often much competition for this sort of low-priced meat in some situations. It was formerly, however, the custom in some places to *knit* them before they were fattened and sold to the butchers or otherways, but much injury and loss being found to be sustained by that method, it has been left off; it being now concluded, on the whole, that the loss by knitting the rams is greater than that which is suffered in the reduction of the price of ram mutton.

The practice of letting out rams in the midland districts for the purpose of improving the breeds of sheep, having produced such beneficial effects, the rise, nature, and progress of it may deserve the attention of the stock-farmer. It has been ably and accurately delineated, in the following manner, by Mr. Marshall, in his *Rural Economy* of that part of the kingdom.

It is stated, that in this district, in general, the management respecting rams is similar to that of other parts of the island; the breeders *rearing* or *purchasing* them. But that it is observable, however, that the advocates of the old breeds, though they will not adopt the modern flock, have fallen, in some degree, into the modern practice of *letting* by the *season*. But that the rams of the *modern* breed are never *fold*; but are passed from breeder to breeder, by the *season* only. And that for the purpose of promoting this intercourse, each principal breeder has his *show* of rams; commencing, by common consent, the 8th of June, and lasting until Michaelmas, or until the season of letting be past. That during a few weeks after the shows commence, every ram-breeder may be said to keep open house. Breeders and others, from all quarters of the kingdom, as well as the promoters of the breed who reside in the neighbourhood, attend these shows; going, in parties, from one to another: some to take, others to see and pass their judgment. And that these private exhibitions close with a *public show*, at Leicester, the 10th of October; when rams of every description, but mostly an inferior sort of the im-

proved

proved breed, are collected; being brought in waggons; many of them from a considerable distance; some to be *sold*, but chiefly to be *let* for the season. That this show has been held, he believes, time immemorial; not, however, for the purpose of *letting*, but for that of *sale*. But the letting of rams by the season, has long, he understands, been a practice in Lincolnshire. However, the origin, in the midland districts, may be traced—to a ram let by Mr. Bakewell, at Leicester fair, about forty years ago, at the low price of sixteen shillings. But humble, however, as was this beginning, it proved, Mr. Marshall says, to be the first stone of the foundation of a department of rural business, that has already risen to an astonishing height, and may, for some length of time, continue to bring in a copious source of wealth to the country. In the management of this business, the principal ram-breeders save annually, twenty, thirty, or perhaps forty ram-lambs; castration being seldom applied, in the first instance, to the produce of a valuable ram. For, in the choice of these lambs, they are led more by blood, or parentage, than by form; on which, at an early age, little dependance can be placed. He adds, that their treatment, from the time they are weaned, in July or August, until the time of shearing, the first week in June, consists in giving them every indulgence of keep; in order to push them forward for the show: it being the common practice to let such as are fit to be let the first season; while they are yet yearlings—provincially *sharhogs*. Their first pasture, after weaning, is pretty generally, he believes, clover that has been mown early, and has got a second time into head: the heads of clover being considered as a most forcing food for sheep. After this goes off, turnips, cabbages, colewort, with hay, and report says, with corn. But the use of this the breeders severally deny, though, collectively, they may be liable to the charge. However this may be, something considerable depends on the *art* of making *up*,—not lambs only, but rams of all ages. Fat, like clarity, covers a multitude of faults; and, beside, is the best evidence their owners can produce, of their *fattening quality*,—their natural propensity to a state of fatness; while in the fatness of the sharhogs is seen their degree of inclination to fat at an *early* age. And that the fattening quality being the one thing needful in grazing stock: and being found, in some considerable degree at least, to be hereditary,—the *fattest* rams are of course the *best*; though other attachments, well or ill placed, as to form, or fashionable points, will perhaps have equal or greater weight in the minds of some men, even in this enlightened age and district. And the shearlings, which will not make up sufficiently, as to form and fatness, are either kept on to another year, to give them a fair chance, or are castrated, or butchered, while sharhogs.

With regard to the showing, it is remarked, that the shows of the principal breeders consist, by common consent, of forty rams each, mostly from one to five years old, they being seldom found efficient after that age; some, however, will continue in vigour to the sixth or seventh year. And that, during the show, they are mostly kept in small inclosures, of two, three, or four acres; with three, four, or more rams in each, according to their ages, and the advancement of the season. And in a corner, or other convenient part of each paddock, a small pen, made with hurdles, is placed; for the purpose of handling them. Into these pens they go, through custom, as tractably as worked oxen to their stalls. Indeed, the old rams, from the unwieldiness of their frame, and the load of fat they have to carry at this season, as well as from habit, will suffer themselves to be handled abroad; and even appear to take pleasure in the respect which they have shewn them. But it is

observed, that of late a new method of showing has been struck out by the leading breeder, and adopted by *one* at least of his followers. Instead of showing them abroad, and driving three or four of them up together in a pen, they are shut up in hovels, and brought out separately, being *never* seen together. He thinks, that among accurate judges, this mode of showing may be well enough; but to those who have had less experience it gives offence, as it deprives them of their best guide, comparison; and he can see no fair advantage accruing from it to the latter.

It is remarked, that though the desirable *points* of a ram are such as have been noticed, the choice of the hirer is determined, in some measure, by the intention for which he is about to hire: as whether it be that of getting wedders, or mere grazing stock: or rams for the purpose of letting. Hence the grazier and the ram-breeder choose different sheep, so as to suit their different purposes. He adds, that the characteristic difference between what is termed a *ram-getter* and a *wedder-getter*, or a good grazier's sheep, is that of the former being every where cleaner and finer, the head small, the bone and ossal light, the flesh good, and the form beautiful. The mere grazier likes a ram no worse for having a strength of frame, and is less scrupulous about his form than the ram-breeder, whose great object is fineness: his ewes, and the natural tendency of the breed, serve to give his offspring size and substance when it is wanted.

In respect to the practice of letting, it is observed, that a novel circumstance has likewise taken place lately in the business of letting. The long established custom of setting a price was exploded, at least by the late Mr. Bakewell, and one of his disciples; whose customers were left to make their own valuations, and bid what they pleased. But this, as well as shewing them separately, it is observed, gives great offence, especially to strangers, who cannot brook the idea of being both buyers and sellers. The latter, however, has more than one advantage in reserving the price, provided he do not thereby drive away his customers: he is, in effect, letting to the best bidder. Beside, he is, through this mean, enabled to *regulate* his *prices* to his customers, without giving any of them pointed offence: for as the principal breeders are, in the nature of their business, competitors, it is no more than common good policy, in the leader at least, to advance himself, and keep back those who press upon him closest. It is, therefore, good management, Mr. Marshall thinks, in him to let a superior ram to an inferior breeder, whose ewes are yet of base blood, at a lower price than to one who is farther advanced, and whose ewes perhaps are nearly equal to his own: for if the hirer may not thereby be able to get the lead from him, he may run away with part of the best prices; and the only line the leader has to tread is, either to refuse him, or to make him pay in the first instance. And again: sometimes two or three capital breeders will join in the hiring of one superior ram; and, in this case, the blood being more widely dispersed, the price ought to be, and always is advanced, in proportion to the number of partners there may be in the business. Hence, in the leader, a reservation of price may be allowable, especially in the letting of first-rate rams.

He observes, in regard to the conditions of letting, that notwithstanding the number of years the letting of rams has now been in use, and the extraordinary height to which the prices have risen, the transaction does not appear to have yet received any settled form; nor to have been rendered *legally* binding, by any written articles, or conditions of letting; much being still left to the *honour* of the parties. It is, however, generally understood, that the price agreed upon

upon shall not be paid, unless the ram in contract, or another as good, impregnate the stipulated number of ewes. If, through accident or inability, part only be impregnated, a proportional part of the price is abated. If he die while at ride, the loss falls on the letter, whether his death happens through accident or neglect; no case, he understands, having yet been otherwise determined. It is likewise understood, that the hirer shall not suffer him to serve any other than his own ewes; and of these, no more than a stipulated number, which is proportioned to the age or ability of the ram, and the mode of using him. And further, that if a grazier hire a valuable ram, at a wedder-getter's price, (which is not unusual at the wane of a season, when valuable rams happen to be unlet,) it is understood, or rather agreed, that he shall not rear rams from him; a condition which may frequently be advantageous to both parties. The letter pockets five or ten guineas, which otherwise he might not have had; and the hirer, by suffering himself to be "tied down," as it is termed, gets a greater improvement in his stock than otherwise he could have got for the same money. He adds, that the time of paying the money is, he understands, unfixed; seldom, he believes, until after the ewes have brought proofs of the ram's efficiency, or after the lambing season.

It is observed, that with regard to the prices for letting rams by the season, that from the first letting to the year 1780, the prices kept gradually rising from *sixteen shillings* to a guinea, and from one guinea to ten. In 1780, Mr. Bakewell let several at *ten guineas* each; and what is rather inexplicable, Mr. Parkinson of Quarendon let one, the same year, for *twenty-five guineas*, a price which then astonished the whole country. That from that time to 1786, Mr. Bakewell's flock rose rapidly, from ten to a *hundred guineas*; and that year he let two-thirds of one ram (reserving one-third of the usual number of ewes to himself) to two principal breeders, for an hundred guineas each; the entire services of the ram being rated at *three hundred guineas*. This excellent breeder making that year, by letting twenty rams only, more than a thousand pounds! and that, since that time, the prices have been still rising. *Four hundred guineas* have been repeatedly given. The above breeder, this year (1789), makes, he understands, twelve hundred guineas by three rams, (brothers he believes,) two thousand of seven, and of his whole letting full three thousand guineas! And that he now lets nothing under twenty guineas; a well-judged regulation, which Mr. Marshall thinks will probably be beneficial both to himself and his customers.

It is added, that, beside this extraordinary sum made by Mr. Bakewell, there are six or seven other breeders who make from five hundred to a thousand guineas each. The whole amount of monies produced this year, in the midland counties, by letting rams of the modern breed for one season only, is estimated, by those who are adequate to the subject, Mr. Marshall says, at the almost incredible sum of *ten thousand pounds*. He knows that it is a popular idea, especially of those who, living at a distance, have only heard of these extraordinary things, without having an opportunity of coming at facts, that the extravagant prices which are talked of are merely nominal; the principal part of the money being returned, the actual prices given being small, in proportion to those held out. This, however, is, he believes, and on the best authority, an erroneous idea. At the first setting out of the high prices, there might be some transactions of that nature; but if ever they existed, they have ceased long ago. Mr. Bakewell at present has the name, at least, of being parsimonious, even to the shepherds

of the flocks on which his rams are employed. His highest present, he understands, is five shillings; if the price be under fifty guineas, only half-a-crown. But the enormoufness of these prices may be explained, he thinks, on other grounds. The *high* prices are not given, he says, by graziers, for the purpose of getting wedders, as grazing flock; but by ram-breeders, for the purpose of getting rams, to be let to graziers: the *highest* being given by the principal breeders only, not for the purpose of getting rams to let to graziers as wedder-getters, but for that of getting rams, to be let out again to inferior tup-men, as ram-getters.

It is further stated, that the graziers' prices run, even now, from one to ten guineas. He has not heard of more than ten guineas being given, by a mere grazier, for a ram, for the sole purpose of getting grazing flock: five or six guineas is the common price. And supposing he gives the highest price, ten guineas, and that the ram serves a hundred ewes, (some single, some double,) the expence of getting amounts to no more than two shillings a head; which is inconsiderable, compared with the difference between a well and an ill grazing sheep, between a sheep that will get as fat at two years old as another will at three; or, in other words, which will, at two years and a half old, fetch ten or fifteen shillings more than his comrades of another breed, but of the same natural size, and going in the same pasture, or feeding on the same sort of food. In respect to the *middle* prices, as those from twenty to fifty guineas, they are, under the present circumstances, equally reconcileable, he thinks, to common sense. If a breeder, who gives fifty guineas, rear ten tolerable rams fit for the grazier's use, and let them at five guineas each, he brings himself home, even the first season of letting, beside having the rams for another and another season, and beside a general improvement in his stock for the future. And those who give the higher prices, as one to two hundred guineas, have, or ought to have, proper bases to build upon, sufficient flocks of well-bred ewes; in which case, they have a fair chance of producing ram-getters, worth, while the present spirit of improvement lasts, twenty to fifty guineas a season. And that with respect to the *very high* prices, they are given by a few first-rate breeders, who are playing a high game, running a hard race, for the pride and profit of being a leader, when Mr. Bakewell is not; a contention which may last as long as Mr. Bakewell, and be at once an honour to his genius, and a reward of his services.

In respect to the treatment of rams after letting, it is remarked that the breeders of rams, as well as of bulls, find it expedient to reduce them from the cumbrous state in which they are shewn, previously to the season of employment; the old rams, in particular, being frequently returned upon their hand, non-efficient. Hence, as they are let, they are transferred to private pastures, and moderate keep; it being a pretty general rule not to shew a ram after he is let, or contracted for to a person.

In the sending out let rams, the usual time of beginning is the middle of September: the means of conveyance, carriages of two wheels with springs, or hung in slings; some of them being large enough to hold four rams. In these they travel from twenty to thirty miles a day; being sometimes sent, in this way, two or three hundred miles, and sometimes more.

It has been observed by the same writer, that the manner of using these rams has lately received a very great improvement. Instead of turning them loose among the ewes at large, as heretofore, and agreeably to the universal practice of the island, they are kept apart, in a separate paddock or small

small inclosure, with a couple of ewes only each, to make them rest quietly; having the ewes of the flock brought to them singly, and leaping each only once. He thinks, by this judicious and accurate regulation, a ram is enabled to impregnate near twice the number of ewes he would do, if turned loose among them, especially a young ram. And he adds, that, in the old practice, sixty or eighty ewes were esteemed the full number for a ram: in the new, from a hundred to a hundred and twenty are allowed. Seven score have been served by one ram in a season: this is, however, much too great a number.

And while at ride, the treatment of the ram is merely that of keeping him well, and free from disorders; suffering him to serve no other than the hirer's own ewes, and of these the limited number only, and to return him safe when he has done; generally the beginning of December: or, if the hirer has met him on the road, (which is customary,) the latter, in return, meets him on his journey home. And the after treatment consists in striving, by every deviseable means, to reload his carcass, and make him fat and handsome for the ensuing show, in order that he may be let again with advantage.

This is the whole of the plan that was pursued in that district, which has led the way to so much improvement in the breeding of sheep flock; and from which the country has derived such vast benefits, and such a number of advantages. But though the above practices have not been lately carried on to their former extent, they are still very considerable. See SHEEP.

It is remarked, that the practice of hiring rams in Romney Marsh is not carried on with the same degree of spirit as it is in Leicestershire, and that rams were of more value for the hiring season some time ago than they are at present, especially when the crops of the above county took place, as then from twenty to one hundred guineas were frequently given. One grazier some time since let rams to the amount of twelve hundred guineas; but the rage is now over, the people not being so foolish as to be duped out of their money, without the prospect of being repaid. It is here the practice with some to ride their ram lambs; but they are said always to be injured in their growth, if not in their constitutions and dispositions, by it. When a ram dies while at ride, the loss falls on the owner, and, beside, he is not paid for the riding. The time of paying is when the rams are removed from the ewes. This is done by carrying them away in carts, or leading them by ropes. The ram lambs are here now mostly selected and saved, in such numbers as are proper for the hirers.

Some time before the riding season, the graziers call and agree for the hiring or purchasing of rams, the general price usually from three to five guineas; but a superior one will bring ten in particular cases, though many good useful ones let at three guineas. Some purchase them to ride, and immediately afterwards sell them in the markets. The rams, which are to be hired, are here shewn all together in pasture fields, which is a disadvantageous method.

In Suffex, until lately, ten guineas were the highest price that was heard of for the sale of any ram. Now some let many of their three-years old rams for fifty; and inferior ones at thirty, twenty, and ten guineas. Some have even been let so high as one hundred guineas.

RAM is also a term used to signify any thing which has a strong smell or taste.

RAM, in *Astronomy*. See ARIES.

RAM of *M. Montgolfier*, *Hydraulic*, in *Mechanics*, a machine for raising water to any given height, which has lately attracted much attention in France. The first person who

employed this method was Mr. Whitehurst, and it was afterwards improved by Mr. Boulton. Its construction and use may be sufficiently understood by the following statement. It serves to raise water by means of the momentum of a stream of water flowing through a long pipe. The passage of the pipe being stopped by a valve, which is raised by the stream, as soon as its motion becomes sufficiently rapid, the whole column of fluid must necessarily concentrate its action almost instantaneously on the valve, and in this manner it loses the characteristic property of hydraulic pressure, and acts as if it were a single solid; so that, supposing the pipe to be perfectly elastic and inextensible, the impulse must overcome any pressure, however great, that might be opposed to it; and if the valve open into a pipe leading to an air-vessel, a certain quantity of the water will be forced in, so as to condense the air, more or less rapidly, to the degree that may be required, for raising a portion of the water contained in it to any given height. Young's *Course of Lectures on Nat. Philos.* vol. i.

RAM, in *Mythology*, the name of the highest god among the Gentoos. When a widow offered herself to be burnt on the funeral pile of her husband, she was encouraged by the presence of a number of attendants, who formed a circle around her, and offered her fresh betel, intreating that, as she would in a short time appear with her husband in the presence of Ram, or their highest god, she would supplicate for various favours for them; and above all, that she would salute their deceased friends, whom she might meet in the celestial abodes, in their names.

RAM, *Battering*. See ARIES.

RAM's-Horns, in *Fortification*, a name given by M. Belidor to the tenailles.

RAM-Head, on board a *Ship*, the name of a great block belonging to the fore and main halliards. It hath in it three shivers, into which the halliards are put, and at its head the eyes are reeved into a hole made there for that purpose.

RAM-Head, in *Geography*, a cape on the S. coast of Ireland, and county of Waterford; four miles E. of Youghal bay. N. lat. $51^{\circ} 56'$. W. long. $7^{\circ} 44'$.—Also, a cape on the S.E. coast of New Holland. S. lat. $36^{\circ} 56'$. E. long. $149^{\circ} 35'$.—Also, a cape of England, on the S. coast of Cornwall, in the English Channel, between Whitehead bay and Plymouth sound. N. lat. $50^{\circ} 19'$. W. long. $4^{\circ} 12'$.

RAM-Hormuz, a town of Persia, in Chusistan; 65 miles S.E. of Sufter or Shuster.—Also, one of the most romantic vallies in Persia, which has been lately placed under the beglerbeg of Bebahan. It is fifteen furlongs in length (the furlong being estimated at $3\frac{3}{4}$ English miles), and from six to eight miles in breadth. The river Jeraki, entering at the eastern extremity, flows through the centre of it, when meeting the Kkoorkhankende, which descends from the mountains six miles E. of the town of Ram-Hormuz, they together force a passage through a low ridge of hills, which skirt the valley to the south. This fertile spot is, at present, in the hands of five hostile chiefs; the first of whom is an Arab, who resides in a mean village, situated at the W. end of the valley, and built amidst the ruins of the ancient city of Ram-Hormuz. The remaining four are Persians, and brothers, who have each a castle, or fortified village; from which they make frequent sallies, and carry off the corn and cattle of their rivals. A great battle was fought in this valley, between Artaxerxes Babegan, and Artabanus, in which the former was victorious, and first assumed the title of "Shah en Shah," or king of kings. Kinneir's *Perf. Emp.* 1813.

RAM'S Island, an island in lough Neagh, Ireland, about two miles from the shore, and containing about six acres.

acres. It is in the western part of the lough, in what is called Sandy bay, and is the only island. One of the round towers, so frequent in Ireland, is found here, and renders it an interesting object from the neighbouring grounds. Dubourdiou's Antrim.

RAMA, or RAMLA, a town of Palestine, which was formerly large, and defended with strong walls; celebrated as the place where St. Paul cured Æneas. The Mussulmen reverence here the tomb of Locnan the wife, and the sepulchres of seventy prophets, said to have been buried here. The church of St. George is the only object now worthy of notice. The place has a kind of market for gall-nuts, fena, and gum arabic, which the Arabs bring lither for sale; 20 miles N.W. of Jerusalem.

RAMA, a town of Dalmatia; 20 miles S.W. of Mostar.

RAMA, or *Ramah*, signifying an eminence, in *Scripture Geography*, a town of Judea, in the tribe of Benjamin, according to the book of Joshua, ch. xviii. v. 20. It was situated towards the mountain of Ephraim, between Gaba and Babel, about seven miles from Jerusalem, according to St. Jerom. This city lay on the road from Samaria to Jerusalem; for which reason Baasha, king of Israel, caused it to be fortified, to obstruct the passage from the land of Judah into that of Israel. This is the Ramatha, or *Ramatbaim-Zophim*, the country of the prophet Samuel. 1 Sam. i. 1—19. and ii. 11. &c. It was on the frontiers of Ephraim and Benjamin; and frontier cities were inhabited by both tribes. Jeremiah probably speaks of this Ramah. Jer. xl. 1, 2, 3. See also ch. xxxi. 15, 16, 17.

RAMA, a city of Naphtali (Josh. xix. 36.), on the frontier of Asher (Josh. xix. 29.)

RAMA, in *Hindoo Mythology*, is the name of a distinguished mortal, in whom their deity Vishnu was incarnated for the purpose of relieving mankind from the tyranny and oppression of Ravana, the malignant king of Lanka, or Ceylon. This incarnation is one of the ten avatars, or descents of Vishnu, and is, in its supposed importance, second only to that of Krishna. It is similarly a popular history, and allusions to it perpetually occur in the writings and conversation of the Hindoos. The invasion and conquest of Lanka is the subject of one of their finest poems, entitled the *Ramayana*; it furnished subjects for the drama, for itinerant bards, and for every purpose of poetry, being replete with magnificent imagery, and abounding in striking incidents. (See *RAMAYANA*.) The mortal parents of this divine hero were Raja Dasaratha, king of Ayodetra (Oude), and his first wife Kahunsiya. Hence this Rama is sometimes stiled *Dafrat Rama*, to distinguish him from other heroic Ramas; and sometimes *Rama Chandra*, meaning of lunar descent.

There are three persons of the name of Rama, recorded as incarnations of Vishnu. One is Bala Rama, the elder brother, by the same parents, of Krishna; the second, Parasu Rama; and the third, Rama Chandra, the subject more immediately of this article. But it has been made a question, whether they be not three representations of one person, or three different ways of relating the same history; and whether any or all of them mean Rama the son of Cush, fir W. Jones (Af. Res. vol. i.) says he leaves others to determine. He deems Rama to be the same as the Grecian Dionysos, who is said to have conquered India with an army of satyrs, commanded by Pan; and Rama was also a mighty conqueror, and had an army of large monkeys or satyrs, commanded by Maruty, son of Pavan. (See *MARUTY*.) Rama is also found, in other points, to resemble the Indian Bacchus: he is, notwithstanding his lunar appellation above noticed, fabled to be a descendant of the sun,

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his wife's name is Sita; and it is very remarkable that the Peruvians, whose Lucas boasted of the same descent, stiled their great festival *Ramafitoa*.

In a charge delivered by Dr. Watson, afterwards bishop of Landaff, to the clergy of the archdeaconry of Ely in May 1780, are many curious and shrewd observations on oriental usages. He notices a "string of customs wholly the same amongst people so far removed from each other as the Egyptians and Peruvians. The Egyptian women, he says, made sacred cakes of flour, which they offered to the queen of heaven, at their principal solar festivals called *Raymi* and *Citua*: the Peruvian women did the same." Almost all the customs described as common to these distant people, the Egyptians and Peruvians, as well as that quoted, are Hindoo customs, ancient and existing.

All the Ramas are famed as great warriors and as youths of perfect beauty. In the Gita, an episode of the *Mahabarat*, Krishna, describing himself to Arjun as pre-eminent among all things and persons, says, "Among those who carry arms, I am Rama." It is Rama Chandra, however, and his lovely Sita, who are the favourite subjects of heroic and amatory poetries: he is described in the *Ramayana* "of ample shoulders; brawny arms, extending to the knee; neck shell-formed; chest circular and full, with auspicious marks; body hyacinthine; with eyes and lips of sanguine hue; the lord of the world; a moiety of Vishnu himself; the source of joy to Ikshwaku's race." He is suitably mated in his faithful Sita, one of the most interesting females in Hindoo poetry. (See under her name for some account of her, and a description of her person.) Rama is also called *Raghava*, or son of *Raghu*, (see these articles,) like Ikshwaku, one of his mortal ancestry. Kaka-paksha-dara, or crow-winged, is an epithet given to the Ramas, and to other warriors, from a certain mode of shaving the head, leaving the hair over the ears only, resembling crow's wings, as is fancied. Shyamula, or blue-bodied, is an appellation of Rama, as well as of Krishna, and of their common prototype, Vishnu; all being represented of hyacinthine hue. It may be here remarked, that several incidents in the *Sri-Bhagavat*, (a history of Krishna,) and in the *Ramayana*, told similarly of their several heroes, seem to mix or approximate, though perhaps scarcely to identify, the characters of Krishna and Rama. Each won a wife by bending an unyielding bow, not very unlike the story of Ulysses. Each is described as overcoming the demon Kumbakarna, and others. Krishna descended into hell; so did Sita, the *fakti*, or energy of Rama. Both have adventures with the bear Jamba. See *JAMBA*, &c.

All sects and tribes, who, under the denomination of *Vaishnavas* (which see), worship Vishnu, (bating such deistical philosophers as sceptically deny the personal existence of inferior deities, attributes, or avatars, of whom see under *JAIMINI*,) agree in stating, that, with the exception of Krishna, the potentiality of the preserving power was never exhibited in such plenitude as in the avatara of Rama. In popularity, and in dramatic, historic, and poetic shapes, it rivals that of Krishna. And as one or more sects adore Krishna as the deity himself, and draw rules for their religious and moral conduct from the *Sri-Bhagavat*; so the sect called *Ramanuj* similarly clothe Rama in almighty attributes, and deem the *Ramayana* a complete body of ethics and morality. See *RAMANUJ*.

In the series of incarnations of Vishnu, called *das-avatara*, or the *ten descents*, to distinguish them from others of less importance, the avatars of Parasu Rama and Rama Chandra are usually placed sixth and seventh, as given under *VISHNU*. Sometimes Krishna is altogether omitted; in which case,

Bala Rama ranks as the eighth. *Mufali* is a name of the third Rama, under which word some notice is taken of him. And of *Parufa* or *Parufba Rama*; see under that article. The name of Rama, or perhaps more correctly of Rami, is one of the many names of Parvati, consort of Siva. The name is also used, beyond the pale of his own sectaries, in supplication and praise. Ram-Ram is a usual salutation, like our good morrow, between friends at meeting or parting, and is used by both Vaishnavas and Saivas; and it is reverently reiterated in times, and in aid, of abstraction (see JAP); and under the operation of feelings of enthusiasm or distress.

The history of the Ramas mixes itself with that of so many others of Hindoo mythological persons, that in many of our accounts of such persons, &c. particulars occur respecting them. Those desirous of farther notice of the Ramas are, therefore, referred, in addition, to the following articles: CEYLON, JAYA, KAHUNSILYA, LAKSHIMAN, LANKA, MARUTY, RAVENA, RAMAYANA, RENEKA, SITA, &c. from which other references point to articles on subjects connected herewith.

RAMADA, or *Nem Salamanca*, in *Geography*, a town of South America, in the province of St. Martha; 90 miles E. of St. Martha. N. lat. $11^{\circ} 10'$. W. long. $72^{\circ} 20'$.

RAMADAN, a sort of lent observed by the Mahometans, in obedience to the express command of the Koran, during which they fast the whole day, from the time the new moon first appears, till the appearance of the next new moon, with such extreme superstition, that they not only abstain from eating, drinking, and women, but dare not wash their mouth, nor even swallow their spittle, from day-break till night, or sun-set.

The men, indeed, are allowed to bathe themselves; but it is on condition they do not plunge the head under water, lest some drops enter by the mouth or ears, &c. But as for the women they are strictly forbidden bathing. Some are so cautious, that they will not open their mouth, to speak, lest they should breathe the air too freely. The fast is also deemed void if they kiss or touch a woman. To make amends, they feast all night till day-break; though the more rigid begin the fast again at midnight; and usually spend more in this month than in six others.

The Ramadan happens at different seasons of the year; and when it is in the summer it is very hard on the labourers. This month once in thirty-three years is in every season of the year, the Turkish month being lunar, and they beginning at the day they can see the moon; whereas the Jews begin their account from the day the moon makes, which is a day before the Turks.

The reason given why the month of Ramadan was fixed upon for this purpose is, that on this month the Koran was sent down from heaven. From this fast of Ramadan none are excused, except travellers and sick persons, under which latter denomination are included all those whose health would be manifestly injured by keeping the fast; but then they are obliged, so soon as the impediment is removed, to fast an equal number of other days; and breaking of the fast is ordered to be expiated by giving alms to the poor.

RAMAG, a word used by some of the chemical writers to express ashes.

RAMAGE, a term used for the boughs or branches of trees. Hence,

RAMAGE-Hawk, or *Falcon*, one that is wild and coy, as having been long among the boughs, preying for itself. All falcons retain this name till they have left the aery; being so called in May, June, July, and August. These are very rarely reclaimed. See BRANCHER, FALCON, and HAWKING.

RAMAGE Velvet. See VELVET.

RAMAGURRY, in *Geography*, a town of Hindoostan, in the Carnatic; 30 miles W. of Trichinopoly.

RAMAH, a town of Arabia, in the province of Nedjed; 120 miles N.W. of Janama.

RAMAH, or *Ramallah*, *Ramola*, *Ramula*, *Ramba*, *Ruma*, or *Remphtis*, a city W. of Jerusalem, between Lydda and Joppa, according to St. Jerom; or between Joppa and Jerusalem, as modern travellers describe it. This is the place which Eusebius and St. Jerom took for Arimathea, the country of Joseph. Matt. xxvii. 57.

RAMAI, in *Natural History*, a name given by many old writers to bole armenic.

RAMAK, in *Ichthyology*, a species of *Sciæna*; which see.

RAMALINGA, in *Geography*, a town of Hindoostan, in Coimbatore; 16 miles S.S.W. of Erroad.

RAMALIS VENA, a name given by some anatomical authors to the vena portæ.

RAMANUJ, the name of a religious sect of Hindoos, of the great subdivision of Vaishnava, who worship Vishnu, the personification of the preserving power of the deity, in his incarnation of Rama. Of this sect some worship Rama only, some his spouse Sita, and some both Rama and Sita conjointly. (See RAMA.) Among the Ramanuj none are addicted to the indecent, or left-handed, mode of worship noticed under the article RADHA as disgracing her votaries. (See farther under SAKTA, and SECTS of Hindoos.) The different sects of Hindoos are distinguishable by a variety of marks on their foreheads; of which a great many are represented in the second plate, with copious explanations in page 404, of the Hindu Pantheon. The sect of Ramanuj are known by a double upright white line on the forehead, with a red line between, or sometimes a circlet or dot. Sometimes the lines are red and the circlet black.

RAMAS, CAPE, in *Geography*, a cape on the W. coast of Hindoostan; 21 miles S. of Goa.

RAMASSERAM, a town of Hindoostan, in the circle of Rajamundry; 35 miles S.S.E. of Rajamundry.

RAMAYANA, the title of a poem in the Sanscrit language, of great celebrity in India, and regarded as sacred by some sects of Hindoos, and greatly venerated by all. Its subject is the exploits of three persons named Rama; but more especially the wars conducted by one of them, named Rama Chandra, for the conquest of Lanka or Ceylon, from its powerful sovereign Ravena, or rather, indeed, for the rescue of his wife from the hands of that tyrant. It is comprised in seven kandas, or books, containing 24,000 shlokas, or metrical stanzas; named thus: 1. Adi-kanda, containing 64 sections, and 2850 stanzas; 2. Ayodhya-kanda, 80 sections, and 4170 stanzas; 3. Aranyaka-kanda, 114 sections, and 4150 stanzas; 4. Keshkinda-kanda, 64 sections, 2925 stanzas; 5. Sundara-kanda, 43 sections, 2045 stanzas; 6. Yudha-kanda, 105 sections, 4500 stanzas; 7. Uttara-kanda, 90 sections, 3360 stanzas. The Ramayana may be called an epic poem, as it is on one continued, interesting, and heroic action. It is second in celebrity only to the Mahabarat, and perhaps superior to it in reputation for holiness. (See MAHABARAT.) We have the authority of sir William Jones for saying, that this great epic poem, in unity of action, magnificence of imagery, and elegance of diction, far surpasses the elaborate work of Nonnus, in forty-eight books, entitled Dionysiaca; and for believing that the heroes of the poems Rama (patronimically distinguished by the name of Dasrat Rama) and Dionysos are the same.

A curious parallel might be drawn between the manners and customs described in these two works, the *Dionysiaca* and *Ramayana*. The processions and rites detailed in the former seem descriptive, with a little licence for poetical embellishment, of those in usage to this day in India. Some of these Bacchic orgies are noticed under our articles *DIONYSIA* and *NONNUS*; which see. A keen etymologist would find innumerable lingual coincidences; and, in truth, many of the names of persons, Bacchus and Dionysos, and of places, as well as original persons, seem soberly traceable to the sacred language and rites of the Brahmins.

So highly is the *Ramayana* venerated, that the fourth class of Hindoos, the *Sudra*, is not permitted to read it. At the end of the first book, a promise is made of great benefit to any individual of the three first classes or tribes who shall duly read it. "A Brahman, reading it, acquires learning and eloquence; a Kshetriya will become a monarch; a Vaishya will obtain vast commercial profits; and a Sudra, bearing it, will become great." Of these distinctions of tribes or classes, the reader will find due notice under *SECTS of Hindoos*. Under *RAMA* we have stated that his name reiterated is used by several sects as a sort of salutation, or benediction. The author of the *Ramayana*, in the vanity of playful egotism, which, from its frequency with oriental poets, has ceased to seem assuming, calls on his readers to "salute Valmiki, the kukila (cuckoo), who, mounted on the branch of poetry, sounds the delightful note of Rām-Rām."

It has been furnished that the *Ramayana*, like the *Mahabarat*, is allegorical, so far as relates to personal adventures; which, in both cases, are mere machinery for the introduction of a concealed system of philosophy and ethics: in the first instance the allegory is *physical*, in the latter *moral*. Under the article *MAHABARAT* the allegorical nature of that extraordinary poem is sufficiently shewn. The *Kurus* and *Pandus*, the heroes of that poem (see *KURU* and *PANDU*), are personifications of virtues and vices. The *Ramayana* and the *Dionysiaca* relate how their respective Indian conquerors led armies of satyrs. (See hereon under *MARUTY* and *RAMA*.) These satyrs, or monkeys, we apprehend to be personifications of winds, or gaseous metaphors. In the *Ramayana* we find the machinery to consist of the sun and planets, fire, the firmament, wind, water, &c. personified in the gods or regents of those bodies, elements, &c. It has been farther furnished, that whenever these two extraordinary poems, the *Mahabarat* and *Ramayana*, shall appear in English, and their allegories be more fully examined, it may possibly be found, that not only the three *Ramas* will melt into one, but that all will amalgamate with Krishna. Some objections to the identity of the *Ramas* have been offered of a chronological nature. Parasu Rama, it is contended, reigned or flourished eight generations before Rama Chandra. Their poetical identity, however, is sufficiently established; and one can scarcely bring such a tissue of allegory, incarnations, and whimsical adventures, to the test of sober historical and chronological accuracy. Persons of these names may have reigned or flourished at any given period, for they have always been very common, and are so still.

The *Ramayana* is so replete with incident, that it is scarcely possible to give any analysis of its subject with sufficient brevity for this work. Unity of action is, however, its characteristic, namely, the recovery of Sita from the hands of her ravisher Ravena, the gigantic tyrant of Ceylon. It may be noticed in passing, that the *Ramayana*, like the *Iliad*, is founded on a rape, and that Sita is the Helen of the Hindoo epic. (See *SITA*.) So inseparably intermixed are the varied subjects of the Hindoo mythological

history, that the discussion of one necessarily brings another under notice. This is the cause of such frequent references to and from the articles under which we have endeavoured to give a succinct account of such a number of subjects of that description, distinct apparently, but in reality connected, and often confounded with each other. On the subject of this article, the *Ramayana*, or for quotations from it, we may therefore refer to the following, among others: *CEYLON*, *LAKSHMI*, *LANKA*, *MANTRA*, *PARASU RAMA*, *MENAKA*, *RAVENA*, *RIEMBA*, in addition to those pointed to in earlier passages of this article, and in those articles just named.

What precedes, referring to the poem bearing the title of this article, is offered respecting the *Ramayana* of Valmiki. There are many other poems of the same name in Sanscrit, Prakrit, Hindvi, and many other Hindoo dialects; as well as in Arabic, Persian, Malayan, and others derived from the like source. These are of course of unequal celebrity and merit; and acknowledged to be greatly distant from Valmiki's divine poem. Even of this it may be said, that the style is frequently flat and diffuse, deficient in ornament, and abundant in repetitions. As well as Valmiki's work, several others, under the same title, are usually considered with more respect than mere profane poems. One is ascribed to Vyasa, the reputed author or compiler of the *Vedas* and *Puranas*. (See those articles.) A considerable portion of several of the latter mythological romances is occupied by the same subject, to wit, the adventures of Rama; but in the *Vedas* no mention is made of this person, except, indeed, in some detached parts, reasonably suspected to have been interpolated by zealous sectaries. The titles even of the philosophical and profane poems, commentaries, &c. that in divers languages owe their origin to the *Ramayana*, would require a catalogue of no inconsiderable extent to contain them. Among these are included many dramatic works. The quotations from, and allusions to its mythological personages and fables, in the works of the minor poets, are incessant; and upon the whole, there is no subject, perhaps, in the whole range of Hindoo mythology, or history, so often in the minds and mouths of that race of all ranks and sects, as the story of the *Ramayana* in some of its bearings. That of Krishna rivals it in popularity. Both are chanted by itinerant bards, who illustrate their subjects by exhibiting a series of pictures from the *Ramayana* and *Mahabarat*. Women singers frequently accompany these eastern troubadours, who are commonly met with in every city, camp, and town of India.

RAMAZZINI, BERNARDIN, in *Biography*, an Italian physician of distinction, was born at Carpi, near Modena, in 1633, where his father was a respectable citizen. Having received a classical education from the Jesuits at his native town, he went to Parma for the study of philosophy at the age of 19, undecided what profession to adopt: at the end of three years he selected that of physic, and received the degree of doctor at Parma in the beginning of 1659. He then repaired to Rome for the completion of his studies, and settled in practice in the duchy of Castro. He was soon obliged by ill health, however, to return to his native air; and, on his recovery, he married, and pursued his profession at Carpi. Finding his reputation increasing, he removed to Modena, at the solicitation of some friends, in 1671, where he met with merited success, and excited the jealousies of his brethren. In 1682 he was appointed professor of the theory of medicine in the university, which had been recently established at Modena, by duke Francis II.; and he continued to fill this office for eighteen years, attending at the same time to practice, and not neglecting the cultivation of polite literature, to which he was particularly partial. The

elegance of his Latin style in his writings, evinces the success with which he pursued the study of the classics. In 1700 he was invited to a professorship at the more distinguished university of Padua, and removed thither. Though somewhat advanced in age, he fulfilled the duties of his chair with an ardour, not to be surpassed by his junior colleagues, for the space of three years, when he was attacked with a disease of the eyes, which threatened to destroy his vision, and which, in fact, did ultimately deprive him of that faculty. Having lost the pleasure of reading, which was the only source of his regret, he supplied that amusement by the assistance of his grand-children, who read to him, and acted as his amanuenses. In 1708, however, the senate of Venice appointed him president of the college of physicians of that capital, and in the following year raised him to the first professorship of the practice of medicine. He continued to perform the duties of these honourable posts, at the earnest solicitations of his constituents and pupils, with great diligence, to the end of his life, and died on his birth-day, November 5th, 1714, in consequence of an attack of apoplexy, which seized him while he was preparing for his lectures, at the age of 81.

Ramazzini was a member of several of the academies of science established in Germany, Berlin, &c., and left several works; the principal of which, and one which will ever be held in estimation, is his treatise on the diseases of artists and manufacturers, entitled "*De Morbis Artificum Diatriba*," first published in 1700, and frequently reprinted. He also published some tracts relative to certain epidemics, both among men and cattle; some "*Ephemerides Barometrice*;" a work on the abuse of Peruvian bark; and several orations delivered in his professorial capacity. All his works have been collected and published together at Padua, Geneva, London, and Naples; the edition of London is the most correct. Eloy Dict. Hist. de la Med. Hutchinson's Biog. Med.

RAMBANG, in *Geography*. See REMBANG.

RAMBERVILLER, or REMBERVILLE, a town of France, in the department of the Vosges, and chief place of a canton, in the district of Epinal; 19 miles E. of Mirecourt. The place contains 4926, and the canton 14,014 inhabitants, on a territory of 317½ kilometres, in 28 communes. N. lat. 43° 21'. E. long. 6° 43'.

RAMBIN, a town of Anterior Pomerania; 10 miles W.S.W. of Bergen.

RAMBLE, a town of Spain, in the province of Cordova; seven miles N.W. of Montella.—Also, a town on the W. coast of the island of Teneriffe; three miles W. of Laguna.

RAMBOUILLET, a town of France, in the department of the Seine and Oise, and chief place of a canton, in the district of Versailles, the seat of a tribunal, and of a national farm, where the sheep are much celebrated for the fineness of their wool; 27 miles S.W. of Paris. The place contains 2586, and the canton 9652 inhabitants, on a territory of 305 kilometres, in 17 communes. N. lat. 48° 39'. E. long. 1° 54'.

RAMBURE, a town of France, in the department of the Somme; 3 miles W. of Oisemont.

RAMBURELLES, a town of France, in the department of the Somme; 9 miles S. of Abbeville.

RAMCHUND-POUR, a town of Bengal; 30 miles N.E. of Calcutta.

RAMCHUNDRA, a town of Hindoostan, in the circle of Mohurbunge; 23 miles S.S.E. of Harriopour.

RAMCHUNPOUR, a town of Bengal; 60 miles N. of Dacca.

RAMCOTTA, a town of Thibet; 18 miles S.W. of Sirinagur.

RAMCOUTY, a town of Hindoostan, in Bahar; 28 miles N.E. of Goorackpour. N. lat. 26° 51'. E. long. 84° 8'.

RAMDILLY, a town of Hindoostan, in the Nays; 25 miles N.N.W. of Tellicherry.

RAMEAU, JOHN PHILIP, in *Biography*, chevalier de St. Michel, composer to the king of France, and to l'Academie Royale de la Musique, or serious opera at Paris, was born at Dijon in 1683. He went early in his life to Italy, and at his return was appointed organist at Clermont en Auvergne, where his "*Traité de la Musique*" was written, in 1722. He was afterwards elected organist of St. Croix de la Bretonnerie at Paris. Here his time was chiefly employed in teaching; however, he published harpsichord lessons, and several other theoretical works, without distinguishing himself much as a vocal composer, till the year 1733, when, at fifty years of age, he produced his first opera of "*Hippolite et Aricie*." The music of this drama excited professional envy and national discord. Party rage was now as violent between the admirers of Lulli and Rameau, as in England between the friends of Bononcini and Handel, or, in modern times, at Paris, between the Gluckists and the Piccinists.

When the French, during the last century, were so contented with the music of Lulli, it was nearly as good as that of other countries, and better patronized and supported by the most splendid prince in Europe. But this nation, so frequently accused of more volatility and caprice than their neighbours, have manifested a steady persevering constancy in their music, which the strongest ridicule and contempt of other nations could never vanquish.

Rameau only answered his antagonists by new productions, which were still more successful; and, at length, he was acknowledged by his countrymen to be not only superior to all competition at Paris, but sole monarch of the musical world. From 1733 to 1760 he composed twenty-one operas, of which the names and dates are annually published in the "*Spectacles de Paris*," and in many other periodical works.

Rameau's style of composition, which continued in favour almost unmolested for upwards of forty years, though formed upon that of Lulli, is more rich in harmony, and varied in melody. The *genre*, however displeasing to all ears but those of France, which had been nursed in it, was carried by the learning and genius of Rameau to its acme of perfection; and when that is achieved in any style, it becomes the business of subsequent composers to invent or adopt another, in which something is still left to be done, besides fervile imitation.

The opera of "*Castor and Pollux*" having been long regarded in France as the master-piece of this composer, we shall here insert a few remarks upon it, that have been made on a recent examination.

The overture is the best of this author, upon Lulli's plan. The opening symphony is beautiful; but why the same melody was not applied, in the same measure, to the poetry, we know not, unless the versification required a change of time; but, in that case, why write the symphony on a subject that would not suit the words? But those eternal changes in the measure, which tease and disappoint the ear of all that are used to other music, is general in serious French operas, and seems as much the fault of the poet as musician. It is, however, wonderful, that this defect was not sooner discovered. The over-charged tenderness of Rameau's music appears in all his slow movements, which are in one style, and generally in triple time. This master perpetually

tually discovers himself to be a great harmonist; but inured to a bad taste and style of composition, as well as to bad fingering, he has only augmented the defects of his predecessors, and rendered what was rude and clumsy in Lulli still more offensive, by endeavours at sweetness or high seasoning. The appoggiaturas, or leaning notes, being so frequently incorporated in the harmony, renders it crude, and the hanging on every note, as if unwilling to relinquish it, checks and impedes the motion of the air, and gives it a slow and languid effect, however lively the theme on which it is composed. Every passage in such melody resembles a French heroic verse:

"Each is an *Alexandrine*, through the song,
That, like a wounded snake, drags its slow length along."

The opening of the second act, "*Que tout gemisse*," is very fine, and the pathos well applied; but the subsequent air, which is cast in an admirable mould, is spoiled by frequent and unnecessary changes of measure; and yet in spite of these defects, and the vocal outrages of mademoiselle Arnould, we were more pleased and affected by this scene, than any other we ever heard at the French serious opera. The march, which has few appoggiaturas in it, is like other Christian music.

The *prelude tendre*, at the opening of the third act, abounds with too many of these drags, which being equally harsh to the ear and injurious to pulsation, seem to prevent the performer from ever falling on his feet; and bar eleventh, the chord of the superfluous fifth, which makes all nature shudder, except our Gallic neighbours, is here continued so long, that it distorts the countenance of every other hearer, like *hierapiera*. The major minuet, page 121, after so long and tiresome a minority, is rich in harmony and graceful in melody. The voice is worse used by the composer than the most insignificant instrument. For after several symphonies that are extremely promising, and the ear has been made to expect a continuation of the prefatory strain, nothing is given to the vocal part but broken accents and dislocated measures. In the *chaconne*, which is admirable, the measure is well marked and well accented. This must long have preceded Jomelli's favourite *chaconne*, and have served as a model to him, Theller, and others, in composing this species of dance. More genius and invention appear in the dances of Rameau than elsewhere, because in them, there is a necessity for motion, measure, and symmetry of phrase. And it may with truth be said, that nothing in Lulli's operas was imitated or adopted by the rest of Europe, but the style of his overtures, or in Rameau's, but the dances.

But though the several merits of this musician have been too much magnified by partizans and patriots in France, and too much depreciated by the abettors of other systems and other styles, as well as patriots of other countries, yet Rameau was a great man; nor can the professor of any art or science mount to the summit of fame, and be elected by his countrymen supreme dictator in his particular faculty, without a large portion of genius and abilities.

The successful revival of his opera of "*Castor and Pollux*" in 1754, after the victory obtained by his friends over the Italian burletta singers who had raised such disturbance by their performance of Pergolesi's intermezzo, the "*Serva Padrona*," was regarded as the most glorious event of his life. The partizans for the national honour could never hear it often enough. "This beautiful opera," says M. de la Borde, "without any diminution in the applause or pleasure of the audience, supported a hundred representations,

charming at once the soul, heart, mind, eyes, ears, and imagination of all Paris."

From this era to the time of his death, in 1767, at eighty-four years of age, Rameau's glory was complete. The Royal Academy of Music, who all regarded themselves as his children, performed a solemn service in the church of the Oratory, at his funeral. And M. Philidor had a mass performed at the church of the Carmelites, in honour of a man whose talents he so much revered. See *BASE*, *BASSE Fondamentale*, and *COUNTERPOINT*.

RAMED, a name given by some chemical writers to rhubarb.

RAMEDEGA, in *Geography*, a town of Hindoostan, in the circar of Gaugpour; 15 miles S.W. of Pada.

RAMEE, a town of Bengal; 50 miles S. of Islamabad.

RAMEEPATAM, a town of Hindoostan, in the Carnatic; 30 miles S. of Ongole.

RAMEËPOUR, a town of Hindoostan, in Allahabad; 35 miles E.N.E. of Gazypour.

RAMELLI, AGOSTINO, in *Biography*, a celebrated Italian mechanist and engineer, was born, in 1530, at Mafanzana, in the diocese of Milan. Having entered the army, he served a considerable time under the marquis de Marignano, a general of Charles V. After this, he served under the duke of Anjou as captain, or engineer, at the siege of Rochelle, in 1573, where he was dangerously wounded, and taken prisoner. When that prince, afterwards Henry III., was called to the crown of Poland, he was the friend of Ramelli, and he nominated him his engineer when on the throne of France. In 1588 he published a work in Italian and French, entitled "*Le Diverse et Artificiose Machine del Capitono Agostino Ramelli*," &c. with nearly 200 figures, describing a great number of machines for various purposes, most of his own invention, and which exhibit much ingenious contrivance. The work is very scarce, and is much prized by the curious.

RAMELSPACH, in *Geography*, a town of Austria; 5 miles S.E. of Meisla.

RAMELTON, or **RATHMELTON**, a small post-town of the county of Donegal, Ireland, situated on a bay at the bottom of Lough Swilly. It is 117 miles N.W. by N. from Dublin.

RAMENAPILLY, a town of Hindoostan, in the circar of Rajamundry; 42 miles E. of Rajamundry.

RAMENTUM, in *Botany*, a form of pubescence in plants, which, as the name signifies, has the appearance of a shaving, being flat, membranous, mostly irregular in size and shape, quite unlike the uniform hairs or bristles of which the clothing of most plants consists. (See *PUBESCENCE*.) The above term was first used, if we recollect rightly, by l'Heritier, and occurs in some species of *Begonia*. The scabiness of Ferns is of a similar nature.

RAMERUP, in *Geography*, a town of France, in the department of the Aube, and chief place of a canton, in the district of Arcis-sur-Aube; 6 miles E. of Arcis-sur-Aube. The place contains 493, and the canton 8870 inhabitants, on a territory of 440 kilometres, in 29 communes.

RAMESAN, an oriental term for a month of fasting, very religiously observed among the Turks, and otherwise called *Ramadan*; which see.

RAMESERAM, in *Geography*, a town of Hindoostan, in the circar of Cuddapa; 6 miles E. of Gandicotta.

RAMETTA, a town of Sicily, in the valley of Demona; 6 miles W. of Messina.

RAMEX,

RAMEX, (*ramus*, a branch,) in *Surgery*, a rupture, or hernia. See **HERNIA**.

RAMEX *Varicosus*. See **CIRSOCELE**.

RAMGAD, in *Geography*, a town of Hindoostan, in Bahar; 10 miles W. of Bahar.

RAMGARY, a town of Hindoostan, in the country of the Nayrs; 19 miles W.N.W. of Palicandchery.

RAMGAUT, a town of Hindoostan, in the subah of Delhi; 37 miles S.E. of Secundara.

RAM-GETTER, in *Rural Economy*, a term applied by the midland breeders to such rams as are proper for getting ram-stock, in contradistinction to such as are fit only for getting wedder-stock. See **RAM**.

RAMGONGA, in *Geography*, a river of Asia, which rises in Thibet, and runs into the Ganges, 10 miles N. of Canoge.

RAMGOT, a town of Hindoostan, in Concan; 25 miles N. of Goa.

RAMGUR, a circar of Bengal, bounded on the N. by Bahar, on the N.E. by Curruckdeagh, on the S.E. by Pachete, on the S. by Nagpour, and on the W. by Koonda and Toree; about 90 miles long, and 60 broad.—Also, the capital of this circar; 175 miles W.N.W. of Calcutta. N. lat. $23^{\circ} 40'$. E. long. $83^{\circ} 42'$.—Also, a town of Hindoostan, in Dowlatabad; 35 miles S. of Neermul. N. lat. $18^{\circ} 30'$. E. long. $79^{\circ} 11'$.—Also, a town of Hindoostan, in Malwa; 8 miles S. of Ragoopour.—Also, a town of Hindoostan, in the subah of Delhi; 5 miles N. of Coel.—Also, a town of Hindoostan, in Guzerat; 50 miles E.S.E. of Surat.—Also, a town of Bengal; 13 miles N.W. of Midnapour.

RAMGUR. See **SESVAH**.

RAMGURRA, a town of Hindoostan, in the Myfore, captured by the English in 1791; 42 miles N.E. of Seringapatam.

RAMHYTTE, a town of Sweden, in Westmanland; 36 miles from Stromsholm.

RAMI, in *Hindoo Mythology*, one of the many names of the goddess *Parvati*; which see. Under this name she is said to be worshipped at the splendid temple on the island called Ramiseram, between Ceylon and the cape named by us Comorin, but which should be called cape Kaumari, or Kumari, another of the names of this goddess, and meaning the virgin. (On this point see **LANKA** and **PARVATI**.) Sami is the name of a tree or wood sacred to Parvati, and she is sometimes called Sami Rami, and it has been upheld that this is the origin of the Semiramis of the Greeks. (See hereon **AL. Ref.** vol. iv. p. 382. vol. viii. p. 256. 8vo. ed.) A description of the celebrated temple of Ramiseram will be found under that article. See also **SAMI**.

RAMJAVENPOUR, in *Geography*, a fort of Bengal; 27 miles S.S.W. of Burdwan.

RAMIFICATION, the production of boughs or branches, or of figures resembling branches.

RAMIFICATIONS, in *Anatomy*, are the divisions of the arteries, veins, and nerves, arising from some common trunk.

RAMIGRI, a word used by some writers as a name for colophony.

RAMILLIES, in *Geography*, a village of France, in the department of the Sambre and Meuse, at the source of the river Geete; worthy of being recorded on account of a battle fought here in the year 1706, between the allies commanded by the duke of Marlborough, and the French under marshal Villeroy. The confederates took the whole of the enemy's baggage and artillery, and about 120 standards, 600 officers, and 6000 private foldiers: about 8000 were killed

or wounded. The loss of the allies did not exceed 3000 men; 13 miles N. of Namur.

RAMING, a town of Austria; 11 miles S. of Steyr.—Also, a town of Persia, in the province of Irak; 40 miles E. of Confar.

RAMINGAM, a town of Hindoostan, in Dowlatabad; 10 miles N. of Oudigher.

RAMINGS DORF, a town of Austria; two miles E. of Steyr.

RAMINCUE, in the *Manege*. A horse gets this name that is rellive, and rellits or cleaves to the spurs; that is, defends himself with malice against the spurs; sometimes doubles the reins, and frequently yerks to favour his disobedience. See **TICKLISH** and **DOUBLE**.

RAMIS, **BARTOLOMEO**, in *Biography*, a Spaniard, the first modern who sustained the necessity of a temperament in musical instruments, of which the tones are fixed. He was contemporary with Franchinus, and in 1482 published a work, entitled "*De Musica, Tractatus, five Musica practica*."

He seems to have converted Pietro Aaron to his opinion: as that theorist manifestly exalts the character of Ramis on all occasions at the expence of Franchinus.

The Spaniard was attacked in a rough manner by Nicholas Burtius, for differing from Guido in his division of the monochord, in a tract entitled "*Musices Opusculum cum Defens. Guidonis Aretini adversus quendam Hispanum veritatis prævaricator*." Bonon. 1487. This tract, printed in black letter, is in the *Ashmolei Collect.* among the books of Ant. Wood.

Burtius imagined the honour of Guido to be injured by the Spaniard, as Guido used the Pythagorean proportions, and had never thought of a temperament. Burtius, in his turn, was handled very roughly by Spataro, the disciple of Ramis (Joannes Spadarius Bononiensis, *Musices ac Bartolomei Rami Paulo ejus Præceptoris honesta Defensio* in Nicol. Burtij Parmenf. *Opus.* Bologna, 1491.); and the venerable Franchinus, finding himself very rudely handled in the dispute by the favourers of temperament, in 1522, when he was upwards of seventy years of age, took up the defence of Pythagoras, as Fontenelle, at near a hundred, did of Des Cartes. After this, the war became general, and continued to rage with great violence for more than a century, between the friends of tempered scales, and the adherents to ancient proportions and equal harmony.

RAMISERAM, in *Geography*, an island in the Indian sea, between the island of Ceylon and the coast of Coromandel; to which there is a passage of about 12 or 14 leagues from the island of Manaar, on the coast of Ceylon. But the advantages that might be derived from this speedy communication are in a great measure prevented by the numberless shallows and sand-banks, which every where interrupt the passage, and which are so high, that many of them are dry except during the monsoons. There is in particular a line of sand-banks, which runs quite across from Manaar to Ramiseram, denominated Adam's bridge, and also Rama's bridge, because God is said to have come by this way into Ceylon. (See **ADAM'S Bridge** and **MANAAR**.) From Rama, Ramiseram takes its name, and it has a large temple dedicated to him. The shortness of the passage from Ramiseram to Manaar is particularly useful on account of the speedy conveyance it affords to people on business, and the communication of intelligence. The messengers who usually go from Columbo to Manaar, a distance of 160 miles, in three days, take boat here, and cross over by Adam's bridge to Ramiseram, and then proceed along the Coromandel coast to Madras. An express

RAMISERAM.

express in favourable weather will run from Columbo to Madras in eight days, and the journey has been accomplished once in seven days. (See MANAAR.) The isle of Ramiseram, which is the limit of the Hindoo religion in more modern times, and of the conquests of the Mussulman princes, is, as we have said, separated from Ceylon by Adam's bridge. The island is low, sandy, and uncultivated, except with a few scattered Palmira and cocoa-trees. The pagodas, for which it is so famous, lie on the Ceylon side, near the sea, and are the resort of innumerable multitudes of different sects of religion in India, during the season of certain festivals. The numerous pagodas are constructed in the same stile with those on the Coromandel coast; and they are surrounded with the houses of the brahmins, priests, and other religious persons, whose zeal leads them to attend on their temples; among whom, in particular, may be seen the descendants of the Tamuls, Telingas, Canarians, Mahrattas, and Orias, who compose a great body of the original inhabitants of the southern peninsula. Their houses are built of the cocoa-tree, in small squares and streets, where their families are seen reclining on the little mud terraces, and under the payals or virandahs. They do not allow Europeans to enter these temples; but they are known to resemble those of the coast in their crowded ornaments, spires of brickwork, long porches in front, and vistas, at the extreme end of which are placed the deities, in an obscure situation, surrounded by lamps burning day and night. The same reserve to strangers subsists among all the southern brahmins. The brahmins allow no labour or cultivation to be carried on in the island of Ramiseram, considering it altogether as sacred. The contributions of those who visit it are sufficient for the support of the temples. Several of the neighbouring Poligar chiefs contribute largely, and some of these rajahs have statues erected to them for their gifts. The chief pagoda has several of these statues in its different squares. Low as the sand lies in this island, good water is easily procured; for on scooping it up, the water collects immediately in the holes; but this is not the case in Manaar and the west coast of Ceylon.

The guardianship of this sacred isle belongs to a family of devotees, called "Byrages," the chief of whom is always doomed to celibacy: the succession being carried on by the sisters or the collateral branch, who only are permitted to marry. This institution is similar to that of the sovereignty of the Travancorians and Nairs of the Malabar coast. The clothes and turbans of the devotees are of a tawny red colour, decorated with large black beads, of a particular kind of wood. From the pagodas just mentioned there runs out a long narrow piece of sand, terminating in a point, within a mile of which is a choultry at Tona Goody. This is a square of houses with a court inclosed for the accommodation of pilgrims, who come to the farthest point of the island to perform their ablutions in the sea, the most sacred and the purest of their ceremonies. A brahmin takes care of this choultry, and a pole with a light is fixed at the end of the point to direct the pilgrim. N. lat. 9° 18'. E. long. 79° 22'. Percival's Ceylon.

Of the temple in this island we shall give some account, extracted from a publication of Mr. Cordiner, who visited it. The external appearance is not remarkably grand, and at a distance, no idea is excited of the minute ornaments and laboured workmanship which strike the eye on a nearer inspection. All the architecture seen without doors is insignificant, compared with the magnificence of the interior. After an examination of the whole structure, which is entirely of hewn stone, Mr. C. deemed the extent of masonic labour in its erection, must have been equal to that of any

of the most splendid cathedrals of Europe. "On entering it we were," he says, "completely astonished at the grandeur of the workmanship, and extent of the dimensions, which far surpassed any idea that we had formed of Indian magnificence." From the west gate a low gallery, 144 feet in length, with three rows of pillars on each side, leads down to the centre of the building; where it branches off, in galleries similarly constructed, to the right and left, each extending 150 feet, then running from west to east 500 feet, and enclosing an oblong rectangular space. The gallery runs also along the centre of the temple 788 feet, and a similar gallery runs across from north to south, where are like entrances, intersecting the former in the centre of the rectangular space. All the galleries have on each side triple rows of massy stone pillars, of highly laboured workmanship. Those in the front line are the largest and most superb, having a huge lion, with the mouth wide open, sculptured in bas relief, above three distinct capitals, over which are a scroll, and a richly ornamented cornice. Statues of the size of life are attached to many of the pillars, representing gods and deified persons. The pillars stand on a continued basement, forming the floor of the galleries, raised three feet, with steps to ascend by, all of stone. The roofs of all the galleries are flat, formed of stones reaching across, from the projection of one cornice to that of the other. The galleries are eighteen feet wide, and in the centre thirty feet high from the floor. The number of pillars within the temple amounts to 2628. The edifice is inclosed by a heavy stone wall, 20 feet high, 830 feet from east to west, and 625 from north to south. Large as these dimensions may appear, they are stated to be but small compared with those of temples on the continent of India, one of which covers a square mile of ground. The covered gallery, fronting the south gate, which seems unfinished, strikingly resembles the entrance of the Elephanta cavern, near Bombay. Solid pyramidal erections surmount the western and eastern entrances, composed externally of a great number of small pillars, two and two, in the form of window frames or gateways, rising one above another, in seven different stories. That over the western, which is the principal entrance, appears to be 150 feet high; the eastern seems lower, and unfinished. The north and south gates are less majestic than the others; but their completion is said to be intended, when they will be similarly surmounted and ornamented as the western portal. Privileged persons, among whom were women carrying water-pitchers, appeared constantly passing and re-passing about the interior of the temple.

Two hundred Brahmins are attached to this temple, and supported in ease and luxury by its endowments. It is dedicated to Siva, the destroying power, called by the vulgar Rama Lingam. It contains likewise, Mr. Cordiner says, images of Vishnu the preserver, and of all the subordinate divinities. Of Brahma, the creator, he states, the Hindoos never dare to form any likeness. This is a common error, that is explained and corrected in the article IDOLATRY of this work.

A broad street runs parallel to each side of the temple composed of comfortable houses, and large choultries for the accommodation of pilgrims and travellers, of stone, with flat roofs supported in front by pillars; the fronts being open. In one of these Mr. Cordiner observed two ivory palankeens inlaid with gold, the property of officers belonging to the sanctuary. In others he noticed five carriages, called by the English Swamy coaches, used for the purposes of carrying the idols in procession: the use to which the ivory palankeens are, we apprehend, also applied.

These

These carriages are described as solid masses of wood, of a pyramidal shape, intended to symbolize the Linga. (See LINGA.) The exterior of these coaches are covered with grossly obscene carving.

At the external corners of the temple, and in the streets of the town, there are smaller temples in honour of different deities, and containing images. In some of the streets spreading trees, among them the ficus religiosa and tamarind, are surrounded with square stone terraces, on which are placed little images of Pollear or Ganefa, (see POLLEAR,) the Linga, two serpents entwined, and other emblems of Hindoo mythology. These terraces are used for contemplation, or more active religious duties, as noticed under the article PRADAKSHNA. Rows of fruit-trees, among them the cocoa-nut, plantain, and pomegranate, stand in gardens beyond the north and south walls of the temple.

On the opposite side of the island, near the sea, distant about eight miles from the temple, is the ancient fort and choultry of Pombom. The road between is very elegantly paved with smooth stones, each six feet by four; and the greater part of the road is nobly shaded by the most beautiful and majestic trees. The larger trees of this superb avenue are surrounded by smooth raised terraces of masonry, on which travellers rest in comfort, completely shaded. About half way between the grand temple and Pombom is a very elegant small temple, built on the same general plan with the larger, having two massy towers raised in the centre of the oblong area, and a covered walk, with three rows of pillars on each side, all round. The outside of the towers is completely covered with statues in miniature, representing all the variety of their mythological divinities. The choultry, for the accommodation of pilgrims and travellers at Pombom, has two fronts, and three inclosed squares; and is surrounded by piazzas raised several feet, with square pillars and terraced roofs. Contiguous is a small temple, the door of which was open, displaying an image of Ganefa or Pollear, in the usual form, elephant-headed and pot-bellied, ornamented with necklaces of flowers.

There are several other elegant temples on this interesting island, which is entirely dedicated to the purposes of religion. No plough is allowed to break the soil, and no animal, wild or tame, is ever killed on it.

Dancing girls, mountebanks, and beggars, abound here, as in other resorts of the idle and wealthy.

The small remains of antiquity still extant on Ceylon, sufficiently prove that similar religious institutions did once exist there, and that choultries and temples were erected at the different stages, all the way from Manaar through the island, 200 miles, to Dondra, its southern extremity, and the ultimate extent of Hindoo pilgrimage. At the latter place, the ruins of a temple dedicated to Siva are still to be recognized; but only some rows of scattered pillars, and a few remnants of broken images, have survived the fanatic fury of the early European invaders. Rama's peaceful island falling under the protection of a more liberal and enlightened government, fortunately escaped those religious tempests, which spread destruction round the coasts of Ceylon.

Lord Valentia has more recently visited this interesting scene, and Mr. Salt, who accompanied his lordship, has published a very elegant view of the temple. The entrance is described to be through a gateway, about 100 feet high, covered with carved work to the summit. The door is 40 feet high, composed of single stones placed perpendicularly, with others crossing. This massive workmanship reminded Lord Valentia of the ruins of Egyptian architecture. He

describes the quadrangle to be about 600 feet each side, and says that, on the whole, this temple is the finest piece of architecture that he had seen in the east. Words, he says, cannot describe its magnificence. The concourse of pilgrims is very great, and brings in a large sum; each paying according to his rank. The raja of Tanjore had been expected the year before, but could not afford it; as in presents and various expences, it was estimated that his highness could not have performed this act of devotion under 60,000 pagodas, about 25,000*l.* sterling. His whole family would of course have expected to participate in the happiness and benefits of the pilgrimage. The idol uses no water but what is brought from the Ganges by fakirs: with this it is bathed every morning; and this holy water, thus acquiring additional sanctity, is fought and purchased by the devout for sin-expelling purposes.

RAMISTS, in the *History of Learning*, the disciples of Peter Ramus, who was born in a small village in Picardy, in 1515, and from being a servant in the college of Navarre at Paris, became, by his talents, industry, and perseverance, one of the most famous professors of the sixteenth century. By attacking the authority of Aristotle, and attempting to substitute in the place of his logic a method of reasoning better adapted to the use of rhetoric and improvement of eloquence, he excited a terrible uproar in the Gallic schools; so that the two first books he published, *viz.* his "*Institutiones Dialecticæ*," and "*Aristotelicæ Animadversiones*," were prohibited through the kingdom of France, and the author prohibited from any more teaching philosophy. His enemies persecuted him with lampoons and satires, and even held him up to public ridicule on the stage. However, Ramus afterwards recovered his credit, so that he obtained the royal professorship of philosophy and eloquence, and afterwards of mathematics, at Paris, in 1547. But his enemies were inveterate in their persecution of him, and as soon as it was known that he favoured the party of the Hugonots, he was obliged once again to withdraw himself from the effects of their resentment. In the intervals of peace, he returned to his station; but in 1568, when the civil war was a third time renewed, he resolved to leave France, and make a tour through Germany. After spending three years in visiting the principal German universities, and receiving many tokens of respect, he resolved, fatally for himself, in 1571, to return to his own country. Accordingly he settled at Paris, where he perished in the massacre on St. Bartholomew's day. On the tumult of this execrable day, Charpentaire, professor of mathematics, who had been eclipsed by the superior talents of Ramus, seized the opportunity of being revenged upon his rival, and, under the pretence of religion, employed assassins to murder him. His body was afterwards thrown into the street to the enraged pupils of Charpentaire, who dragged it ignominiously along the streets, and then cast it into the Seine.

The disciples of Ramus, such was the astonishing influence of their master's learning and character, prevailed so far as to banish the Peripatetic philosophy from several seminaries of learning, and to substitute in its place the system of their master, which was of a more practical kind, and better adapted to the purposes of life.

Although he had considerable merit in exposing the defects and inconsistencies of the Aristotelian philosophy, he does not seem to have been equally successful in his attempt to establish a new logical institute. The general outline of his plan is as follows. Considering dialectics as the art of deducing conclusions from premises, he endeavours to improve this art, by uniting it with that of rhetoric. Of the several branches of rhetoric he considers invention and disposition

position as belonging equally to logic. Following chiefly the example of Cicero, he divides his treatise on Dialectics into two parts; the first of which treats of the invention of arguments, the second of judgments. Arguments he derives not only from what the Aristotelians call middle terms, but from any kind of propositions, which, connected with another, may serve to prove any assertion. Of these he enumerates various kinds. Judgments he divides into axioms, or self-evident propositions, and "dianoëa," or deductions by means of a series of arguments. Both these he divides into various classes; and illustrates the whole by examples from the ancient orators and poets.

In the logic of Ramus, many things are borrowed from Aristotle, and only appear under new names; and many others are derived from other Grecian sources, and particularly from the dialogues of Plato, and the logic of the Stoics. Whilst the author has the merit of turning the art of reasoning from the futile speculations of the schools to forensic and common use, his plan is defective in confining the whole dialectic art to the single object of disputation, and in omitting many things which respect the general culture of the understanding, and the investigation of truth. Defective as the system of Ramus is, lord Bacon (*Augm. Sc. l. vi. c. 2.*) has passed too severe a censure upon him, and others have concurred in it: for he is unquestionably entitled to great commendation for having, at the period in which he lived and wrote, with so much firmness and perseverance, asserted the natural freedom of the human understanding. The logic of Ramus obtained great authority in the schools of Germany, Great Britain, Holland, and France; and science derived ultimate advantages from the contests which were maintained between the followers of Ramus and those of the Stagyræ. But the fame of Ramus vanished before that of Des Cartes. *Brucker's Phil. by Enfield, vol. ii.*

RAMLA, in *Geography*, the original *Arimathea*, a town of Palestine, distant one-third of a league from the village of Ludd, or the ancient Lydda and Diospolis. This town is almost in as ruinous a state as Ludd itself. Within its boundaries nothing is found but rubbish; nevertheless, the aga of Gaza resides here in a *ferai*, the floors and walls of which are tumbling down. He maintains about 100 horsemen, and as many Barbary soldiers, who are lodged in an old Christian church, the nave of which is used as a stable, and in an ancient *kan*, which is disputed with them by the scorpions. The adjacent country is planted with lofty olive trees, disposed in quincunxes. Amidst these plantations, which are decaying, are found dry wells, cisterns fallen in, and vast vaulted reservoirs, which prove that, in ancient times, this town must have been upwards of $1\frac{1}{2}$ league in circumference. At present it scarcely contains 200 families. The little land, which is cultivated by a few of them, belongs to the mufti, and two or three of his relations. The rest content themselves with spinning cotton, which is chiefly purchased by two French houses established there. At Ramla there is also a soap manufactory, the produce of which is almost wholly sent to Egypt. In 1784 the aga built here a wind-mill, which, says Volney, is the only one I have seen in Syria or Egypt, though they are said to have been invented in these countries. The only remarkable antiquity at Ramla is the minaret of a ruined mosque on the road to Yafa. By an Arabic inscription, it appears to have been built by Sai-el-din, sultan of Egypt. From the summit, for it is very lofty, the eye discerns the whole chain of mountains, which begins at Nablous, and skirting the plain, loses itself toward the south. Volney's *Travels in Egypt and Syria, vol. ii.*

RAMLEAH, a mountain of Arabia, in the province of Nedsjed, extending from S.W. to N.E. about 250 miles; the S.W. extremity being 80 miles E. of Kalaat el Moilah.

RAMLER, CHARLES-WILLIAM, in *Biography*, a celebrated German poet and professor of belles lettres at Berlin, was born at Colberg in the year 1725. He was distinguished at a very early period by his poetical genius; and in 1754 published a poem, entitled "The Game of Chess," which displayed a considerable share of genius. In 1758 he translated the abbé Batteaux's *Treatise on the Belles Lettres*, which he adapted to the genius of his native language, and added some dissertations on the German style and versification. In the following year he published, in conjunction with Lessing, the epigrams of Logan, an author who, notwithstanding his great merit, had been suffered to remain in obscurity. In 1760 he published "Sacred Cantatas," which were followed, during the next 20 years, by a great number of other publications, chiefly poetical, of which a list is given in the *General Biography*. In the year 1780 Ramler turned his attention to several of the old German poets, and published at Leipzig the *Epigrams of Wernike, Opitz, Tscherning, Andrew Gryphius, and Adam Olearius*. He was so successful in polishing the works of others, and gave such proofs of his taste and critical talents, that Göze, one of the most distinguished German amatory poets, allowed him full liberty in his last will to retain or reject such parts of his poems as he might think proper. In 1782-3 he published at Berlin a translation of the poetical pieces in the different volumes of the *Spectator*, which he followed, in the subsequent ten years, by a variety of other works on different subjects; among which may be mentioned "A short Introduction to Mythology, in two Parts." Ramler has been styled the German Horace; and his biographer says, that though his verses display perhaps less boldness and simplicity than those of the Roman, they equal them in sublimity, and surpass them in harmony. It has been remarked to the honour of Ramler, that he attached to him Frederic the Great, and his successor, by his poetical talents: from the latter he had a considerable pension paid him during the closing years of his life. Ramler was one of the directors of the national theatre at Berlin, and professor of the belles lettres in the school of the corps of cadets; but the latter office he resigned in 1790. *Gen. Biog.*

RAMME, in *Geography*, a river of the duchy of Bremen, which joins the Oste, near its source.

RAMMED *Earth Buildings*, in *Rural Economy*, are such as are raised with some sort of earthy material. This mode of building with earthy materials is supposed by some to have been known at a very early period, and has been long practised with success in the southern parts of France, especially about Lyons, though but little understood in any other part of Europe until lately. This method has, however, appeared to have so many advantages, that it was made trial of in different places in this country; and the result has been so favourable, that the practice seems to deserve the attention of the proprietors of land, in all situations where buildings are to be erected on a cheap and economical plan. In order to facilitate the knowledge of the art, Mr. Holland has presented the public with the method of performing the business, in a paper, translated from a French work on the subject, inserted in the first volume of *Communications to the Board of Agriculture*, in which he says that the French writer, M. Francois Cointeraux, remarks, that the possibility of raising the walls of houses two or even three stories high, with earth only,

which will sustain floors loaded with the heaviest weights, and of building the largest manufactories in this manner, may astonish every one who has not become an eye-witness of such things. It is a method, which in the above district of France is known by the term *pisé*; but as it is accomplished by the ramming or compressing earth, or earthy substances, in moulds or cases, the above term has also been applied to it. See *Pisé*, *Building* in.

RAMMEKENS, in *Geography*, a sea-port town of Holland, in the isle of Walcheren, formerly one of the best harbours in Zealand. This town, which was constructed as a fortress in the year 1547, and called "Zeebourg," was one of the towns pledged to queen Elizabeth by the states general for the succours she lent them against Spain in the year 1585; three miles E. of Flushing.

RAMMEL, in *Agriculture*, a term applied to a substance which forms a part of the subsoil or substrata of particular districts. It is usually covered with a thin weak earth or mould in some places. It is penetrable by the roots of some plants, but notwithstanding that, is very unfriendly to the vegetation of plants in general. It is frequently met with in Cheshire and some other counties. See *SOIL*.

The term signifies a composition of various kinds of clay, white sand, and gravel, which is intimately intermixed with a small portion of oxyd of iron. It is for the most part found under a weak brown or grey earth which is rarely more than four or five inches in depth in the above district, lying in strata of from eighteen to thirty inches in thickness, upon a white or red sand or clayey marle, the latter often partaking of its nature for the depth of some feet. Rammel or rammelley soils are therefore constantly of a barren and unproductive nature.

RAMMELBERG, in *Geography*, a large and lofty mountain in Westphalia, celebrated for its mines. These mine-works yield lead, copper, silver, some gold, borax, lapis calaminaris, zinc, sulphur, jet, vitriol, and yellow ochre. It lies near Goslar.—Also, a town of Westphalia, in the county of Mansfeld; three miles S.E. of Wippra.

RAMMELLY, in *Agriculture*, a word used to signify such crops as are tall or rank, as beans, &c.

RAMMER, a well-known implement formed of wood in different ways, according to the purpose for which it is to be used. These implements are very necessary in putting posts into the ground, in inclosing land, in order to close the earth firmly about them, as well as for laying down turf or sward, in order to render it smooth and even. See *BEETLE*.

RAMMER of a Gun, the *gun-stick*; a rod or staff used in charging a gun, to drive home the powder to the breech, as also the shot, and the wad, which keeps the shot from rolling out.

The rammer of a great gun is a cylinder of wood, whose diameter and length are each equal to the diameter of the shot, with a handle fixed to it. See *SPUNGE*.

RAMNA, in *Geography*, a mountain of Bosnia; 16 miles N. of Orach.

RAMNAGUR, a town of Hindoostan, in Bahar; 42 miles N.E. of Durbungah.—Also, a town of Bengal; 10 miles N.E. of Kisheragur.—Also, a town of Hindoostan, in Oude; 27 miles N.E. of Lucknow.

RAMONCHAMP, a town of France, in the department of the Vosges, and chief place of a canton, in the district of Remiremont. The place contains 2385, and the canton 11,325 inhabitants, on a territory of 245 kilometres, in 6 communes.

RAMONDON, **LEWIS**, in *Biography*, an English singer, who first appeared on the stage of Drury-lane in 1706. But

he sung in Arsinoe, and Pyrrhus and Demetrius, when these operas were performed at the Queen's theatre in the Hay-market. He appears no more as a public singer after this period, but his name occurs as a composer in a collection of songs called the "Merry Musician," 1716; and as the editor of "the song tunes in the opera of Camilla, contrived and fitted to the harpsichord or spinet;" in the title of which it is said, "that the lessons being placed on five lines render them proper for a violin and a base." Almost all organ and harpsichord music was till this time written and printed on six lines.

RAMOO, in *Geography*, a town of Aracan; 60 miles N.N.W. of Aracan.

RAMOR, **LOUGH**, a lake of Ireland, in the southern part of the county of Cavan, which contains several islands, on which are beheld the ruins of some ancient castles. These were formerly adorned with wood, but are now bleak and desolate. The river Blackwater, which issues from it, joins the Boyne at Ravan. Lough Ramor is about 13 miles S. from Cavan.

RAMOS, or **LAMOS**, a river of Africa, which runs into the Atlantic, 60 miles N.N.W. of cape Formosa. N. lat. 5° 45'.

RAMOS, Dos, an island in the river of the Amazons, about 70 miles long, and from 10 to 20 broad; 60 miles above Pauxis.

RAMOSE LEAF, in *Botany*. See *LEAF*.

RAMOTH, in *Scripture Geography*, a famous city of Palestine, in the mountains of Gilead, and hence called Ramoth-Gilead. This city belonged to the tribe of Gad. It was assigned to the Levites, and was one of the cities of refuge beyond Jordan. According to Eusebius, it was 15 miles E. from Philadelphia; but St. Jerom places it in the vicinity of Jabok, and consequently N. of Philadelphia.

RAMOUCH, in *Geography*, a river of Thibet, which runs into the Dewa, N. lat. 30° 20'.

RAMOURY, a town of Hindoostan, in the circar of Hindia; 20 miles E. of Hurdah.

RAMPAH, a town of Hindoostan, in the circar of Rajamundry; 40 miles N. of Rajamundry.

RAMPANT, in *Heraldry*, is applied to a lion, bear, leopard, or other beast, in posture of climbing, or standing upright upon his hind-legs, and rearing up his fore-feet; shewing only half of his face, as one eye, and one ear.

The term is French; and signifies, literally, *creeping*.

It is different from *saliant*, which denotes a posture less erect, or somewhat stooping forwards, as if making a fall.

This posture is to be specified, in blazoning, in all animals, except in the lion and gryphon; it being their natural situation.

RAMPARA, in *Geography*, a town of Hindoostan, in Concan; 20 miles N. of Gheriah.

RAMPART, or **RAMPIER**, in *Fortification*, a massy bank, or elevation of earth about the body of a place, to cover it from the direct fire of the enemy, and of sufficient thickness to resist the efforts of the cannon for many days; and formed into bastions, curtains, &c.

The word is formed from the Spanish *amparo*, *defence*, or *covering*.

Upon the rampart the soldiers continually keep guard, and pieces of artillery are planted there for the defence of the place. Hence, to shelter the guard from the enemy's shot, the outside of the rampart is built higher than the inside, *i. e.* a parapet is raised upon it with a platform. Hence, also, earth not being capable to be raised perpendicularly, like stone, the rampart is built with a talus or slope, both on the inner and outer side.

The rampart is sometimes lined, *i. e.* fortified with a stone wall withinside, otherwise it hath a berme.

It is encompassed also with a moat or ditch, out of which the earth that forms the rampart is dug.

The height of the rampart should not exceed three fathoms, this being sufficient to cover the houses from the battery of the cannon: neither ought its thickness to be above ten or twelve, unless more earth be taken out of the ditch than can be otherwise bestowed. See CONSTRUCTION, according to *M. Vauban's first Method*.

The ramparts of half-moons are the better for being low, that the small fire of the defendants may the better reach the bottom of the ditch; but yet they must be so high as not to be commanded by the covert-way.

RAMPART is also used, in *Civil Architecture*, for the space left void between the wall of a city and the next houses. This is what the Romans call *pomerium*, in which it was forbid to build, and where they planted rows of trees, for the people to walk and amuse themselves under.

RAMPARTS, in *Geography*, a town of Bengal; 8 miles S.E. of Rungpore.

RAMPERING, or SODDING, denotes the process of building sod or turf walls, or banks.

RAMPFERSGRUBE, in *Geography*, a town of Germany, in the county of Henneberg; six miles W. of Meinungen.

RAMPHASTOS, the *Toucan*, in *Ornithology*, a genus of birds of the order *Picæ*, of which the generic character is as follows: Bill very large, light, hollow, convex, serrate at the edges; each mandible incurvate at the tip; nostrils behind the base of the bill, long, narrow; the tongue is feathered at the edges, the feet mostly climbers.

The birds of this genus first became known to naturalists on the discovery of South America, and to the warmer regions they appear, in general, to be confined. Like the hornbills, they are distinguished by the size of their beaks, which, in some species, is nearly equal to that of the whole body. It is, however, of a very light substance, and, in the living bird, it is compressible between the fingers. Both mandibles are serrated in an outward direction; the tongue is of a highly singular form, representing the appearance of a very narrow lanceolate feather, being of a somewhat horny or cartilaginous nature, and divided on each side into innumerable short and close-set fibres; in consequence of which structure it was described by some early writers on natural history as a real feather, supplying the place of a tongue. The orbits of the eyes are generally bare. The toucans are supposed to feed on fruits, but in a state of captivity they will eat animal food. They deposit their eggs, which are usually two in number, in the hollows of trees, on the surface of the decayed wood. These birds have been as yet met with only in South America, and there merely between the tropics, being totally incapable of sustaining the cold. They are easily tamed and familiarized, and several species have been brought to England, where fruits, fish, and flesh have been promiscuously devoured by them with considerable voracity. Whatever was received by the bill was thrown into the air, and on its return caught, and, without the slightest mastication, instantly devoured. There are seventeen species enumerated by Gmelin, though Mr. Latham mentions only fifteen.

Species.

VRIDIS; Green Toucan. Green, with a yellow belly, and red rump. This species is found in Cayenne, and is about fourteen inches long. The upper mandible is yellow, with red sides, and a black line in the middle; the lower

one is black, the base and round the nostrils are red; the teeth in both are white; the irides and naked orbits are yellow; the legs are of a lead colour; the claws are black; the tail is wedged, beneath inclining to ash; head, chin, and throat, in the male black, in the female bay, terminated by a black narrow transverse band.

EDENTULUS; Toothless Toucan. In this the bill is not serrate at the edges. It inhabits Cayenne, and is twelve inches long. The upper part of the body is green, but beneath it is more of a yellowish colour; the head and neck are chestnut; the rump is red; the upper mandible is brown, the lower black; the thighs green, and it is thought to be a variety of the *viridis*.

PAVONICUS; Pavonine Toucan. The general colour of this is green; but the feathers are sprinkled with red spots. It is also known by a mixture of red and changeable or peacock-coloured feathers interspersed. The bill is variegated yellow and black; the legs and claws are black.

PIPERIVORUS; Piperine Toucan. Green; the fore parts are black; the vent and thighs red. This species has been described by Edwards under the name of the green toucan. Its length is about seventeen inches, and its general colour is of a dull green; the head, neck, and breast, are of a deep black; behind each ear is a somewhat lengthened orange-coloured spot, and immediately behind the lower part of the neck is an orange-coloured bar or collar; the belly is pale and yellowish-green; the thighs are purple; the vent is red, and the tail, which is cuneated, slightly tipped with dull red; the bill is about three inches long, and of a black colour, but towards the base it is varied with red, whitish, and orange-yellow. In the female the head, neck, and breast, are brown instead of black, and the lower part of the belly is grey. It is a native of Cayenne, and said to feed on the pepper of the country. The female of this species has been known to vary in having the bill of a horn colour, with a black bar near the end, and two others near the edge; the ridge also being black, and the yellow crescent at the neck is wanting.

ARACARI. This species is green, but the abdominal band, vent, and rump, are red; the belly and breast are yellow. It is a native of Brazil, Surinam, and Cayenne, and is full sixteen inches long. The upper mandible is black on the back and tip, but the sides are whitish. The base is three-lobed at the nostrils, with a white arch at the root, lower black; the head, the wings, and tail, are black; the breast and body are yellow and scarlet, with a black roundish spot in the middle of the breast, and a similar transverse one on the beginning of the belly; the thighs are tawny.

TORQUATUS; Collared Toucan. This bird is black above, and beneath it is whitish; the belly is green, the hind part is red, and the collar red. It inhabits the coasts of New Spain, is about eighteen inches long, and feeds on fish. The upper mandible is blackish, and the lower black; the irides are of a reddish-yellow; the head and neck are black; the lower tail-coverts are red; the thighs purple; the legs are of a greenish-ash colour; the claws are black.

PISCIVORUS; Brazil Toucan. This is blackish, but the abdominal band and vent are red; the rump is white. It inhabits South America, and is twenty-one inches long. The bill is yellow, with a scarlet spot on the tip; the lower mandible is blue; the cap, back, wings, tail, belly, and thighs, are black; the temples, chin, breast, and rump, are white.

ERYTHRORYNCHOS; Red-beaked Toucan. Blackish; cheeks, chin, and throat, white; upper tail-coverts sulphur, but the lower and crescent on the breast are red. This is

found in various parts of South America. The base and back of the bill are yellow; tip of the upper mandible, and hollow of the lower, red; the nostrils are edged with black; the orbits are blueish; the legs are plumbeous, and the claws are black.

TUCANUS; Yellow-breasted Toucan. This is also blackish; the abdominal band, vent, and rump, yellow. It measures about nineteen inches in length, and has been described by Mr. Edwards from a living specimen brought into England. According to this gentleman, the bill of this species is large in proportion to the size of the bird; it is compressed sideways, having a sharp ridge along its upper part, and toothed on its edges; the upper mandible is green, with a long triangular spot of orange colour on each side, and the ridge on the upper part yellow; the lower mandible is blue, with a shade of green in the middle; the point is red; it has about five transverse faint dusky bars, which cross the joinings of the two mandibles; the nostrils are invisible in the black line that surrounds the bill; the iris of the eye is of a fair green colour; round the eye is a broad space of naked skin, of a violet colour; the skin beneath the feathers is of a violet colour, below which is a bar of scarlet feathers, which parts the yellow on the breast from the black on the belly; the covert-feathers of the tail are white above, and those beneath are of a fine red; the crown of the head, upper part of the neck, the back, wings, belly, and tail, wholly black, though on the upper side of the wings and tail it has a changeable gloss of blueish-purple; the legs and feet are all of a blue or violet colour. The specimen from which this description was made, was brought from Jamaica, but the bird is a native of the hotter parts of South America.

PICATUS; Preacher Toucan. Blackish; breast yellow, vent and tips of the tail-feathers red, rump black. It inhabits Guinea and Brazil, and is more than twenty inches long. The bill is yellowish-green, tipped with reddish; the belly is red; the tail is dotted with red at the tip. This bird is said to have a frequent habit of moving its head from side to side, while uttering its notes; hence it has obtained the name of preacher.

DICOLORUS; Yellow-throated Toucan. Blackish; breast, belly, vent, and rump, red; the chin is yellow. It inhabits Cayenne, and is seventeen inches long. The bill is olive, with a black base; the mandibles are edged with red; the cheeks are of a sulphur colour; the throat is orange, but edged with sulphur.

TOCO; White-throated Toucan. Blackish; chin, throat, and rump, white; orbits, circle on the breast, and vent, red. It inhabits Cayenne, and is about nine or ten inches long. The bill is of a reddish-yellow, the base is black; the upper mandible is black at the tip.

INDICUS; Indian Toucan. The throat, quill-feathers, and tail, black; the cheeks and breast are white; belly and thighs are yellow; the crown is of a reddish-orange; rump crimson. It is found in divers parts of India. The bill is hardly serrate, and not so large as in the others.

LUTEUS; Yellow Toucan. This is of a yellowish-white; the neck is marked with two black lateral stripes; the tail and wings are variegated with black and white; the lesser wing-coverts are yellow. It inhabits New Spain, and is about the size of a pigeon. The bill is black; the irides are yellow; the legs are brown; the claws are yellowish.

CÆRULEUS; Blue Toucan. Blue mixed with cinereous. It inhabits the coasts of New Spain. The bill is longer than the body; the eyes are black and the irides are tawny.

DUBIUS. This is the blue-throated toucan of Mr. Latham, described from a catalogue of the museum of baron

Fangeres of Montpellier, where it is announced as an undescribed species.

ALBUS; White Toucan. This is entirely white.

RAMPICHERLA, in *Geography*, a town of Hindoostan, in the circar of Guntoor; 12 miles N.E. of Innacoda.

RAMPIN, in the *Mangee*. See **TOE**.

RAMPION, in *Botany*. See **RAPUNCULUS**, of which Dr. Johnson supposes it a corruption. See also **PHYTEUMA**.

RAMPIONS, *Crested*, a species of the *lobelia*.

RAMPIONS, *Common esculent*, a species of the *campanula*; which see.

RAMPIONS *with scabious heads*. See **JASIONE**.

RAMPOUR, in *Geography*, a town of Bengal; 13 miles N. of Curruckpour.—Also, a town of Hindoostan, in Bahar; 31 miles N.W. of Bettiah.—Also, a town of Almora; 30 miles N.N.W. of Bereilly. N. lat. 28° 45'. E. long. 79° 22'.—Also, a town of Hindoostan, in Oude, on the Ganges; 34 miles N.W. of Manickpour.—Also, a town of Hindoostan, in Oude, on an island formed by the divided stream of the Dewah; 35 miles N.E. of Lucknow.—Also, a town of Hindoostan, in Oude; 25 miles E.S.E. of Goorackpour.—Also, a town of Hindoostan, in Oude; 30 miles N.E. of Goorackpour.—Also, a town of Hindoostan, in the Carnatic; 30 miles S.W. of Nellore.—Also, a town of Hindoostan, in the circar of Boggilund; 20 miles W. of Rewah.—Also, a town of Hindoostan, in Benares; 20 miles N.W. of Bidzigur.—Also, a town of Hindoostan, in the circar of Schaurunpour; 23 miles S.S.W. of Schaurunpour.—Also, a town of Hindoostan, in the circar of Oudipour; 40 miles E.N.E. of Oudipour.

RAMPS, in *Fortification*, are gentle slopes made for the cannon to be drawn up and down by, and also for the easy communication of the troops posted in a battery that is raised above the level of the ground on which it is built. The rise of these slopes is about two inches, on twelve of base, or the length of the ramp's base is six times the height, and this is general for the draught of carriages; but footways need not be of so gentle a slope, as a rise in one foot in three may answer the purpose; or, instead of ramps, stairs may be, and commonly are, used for the passage of the foot. The breadth of a carriage ramp is usually about nine or ten feet, that breadth being sufficient both for the carriage and footway; but those for foot-passage only need not be above three or four feet wide. Ramps may either rise on the side of an elevated work, or against a salient angle of that work, or on each side of an entering angle.

RAMQUILLA, in *Geography*, a town of Sweden, in the province of Smaland; 5 miles N.W. of Calmar.

RAMSAY, ALLAN, in *Biography*, a poet of considerable celebrity, who wrote in the Scottish dialect, was born in the year 1686, in the parish of Crawford, Lanerkshire. He received no other education than that of the parish school, and was apprenticed to a barber in Edinburgh. It has not been ascertained when he first began to make verses; but about the year 1715, several of his poems had been published. Soon after this he laid aside the trade to which he had been brought up, and adopted the more congenial one of a bookfeller. In 1721 his detached poems were published, by subscription, in a quarto volume. In 1724 he began to publish his collection of songs, entitled "The Tea-table Miscellany," which at length extended to four volumes. This work was followed by one, entitled "The Evergreen," being a collection of songs written by the ingenious before the year 1600. These publications were well received; but his fame was greatly extended by his

"Gentle Shepherd," which was afterwards enlarged from two pastoral poems, in the form of a regular drama. He now held a correspondence with several poets and other ingenious persons of the time, and his shop in Edinburgh was the resort of the men of letters who then flourished in the capital of Scotland. He is supposed to have opened the first circulating library in that city, and in 1736 he built a play-house, which was the first ever known at Edinburgh; but the act prohibiting the exhibition of plays in unlicensed buildings, caused it to be shut up. Ramsay, towards the middle of his life, withdrew from the field of authorship, and attended to the much more profitable business of selling, rather than writing of books. He died in 1758, at the age of 71. The poems of Allan Ramsay, says an eminent critic, "display none of the fire of the genius so conspicuous in those of Burns, but have occasionally an agreeable pastoral simplicity, and are often marked with a vein of humour, natural, though coarse. The Gentle Shepherd is, perhaps, one of the best pastorals with respect to the pictures of real life, which are drawn with great propriety, and generally present pleasing images."

RAMSAY, ALLAN, son of the preceding, was born at Edinburgh about 1709, and having devoted himself to painting, went at an early period of his life to study in Italy, and there received instructions from Solimene and Imperiale.

After his return, he practised in Edinburgh for some time, but afterwards removed to London, and by the influence of his countryman, the earl of Bute, was introduced into the vortex of the court, painted the prince of Wales, and on the death of Shackleton in 1767, was appointed principal painter to the crown; although Reynolds was then in possession of the highest reputation.

Ramsay never ventured to attempt the higher walks of the art, but confined himself solely to portraits, which he painted agreeably. Not possessed of brilliancy of genius sufficient to attempt strong character, with striking effects in his pictures, he contented himself with that portion of art which meets the expectations of common observers; never offending with affectation or neglect, he finished his pictures with care and neatness, and retained his friends and reputation till he ceased to practise. He was so far attached to his art, that he visited Italy four times: to what purpose does not appear, unless it were to derive benefit from the portraits of Pompeo Battoni; for no traces of higher character are observable in his productions. Yet he was a man of sound sense and strong understanding; possessed of literary acquirements, and devoted to study. Though he understood the Latin, French, and Italian languages, he was not satisfied till he added a knowledge of the Greek, acquired when he was advanced in life. Thus endowed, he was emulous of literary fame, and published, under the title of "The Investigator," Essays on Ridicule, as the test of truth, on the Naturalization of Foreigners, on Taste, &c.; and, as occasion prompted, the town was favoured by him with some fugitive pieces on the politics of the day. He was always held to be highly estimable as a man, and enjoyed his fame and good fortune to about the advanced age of 75.

RAMSAY, ANDREW MICHAEL, called the chevalier Ramsay, was born at Ayr, in Scotland. He received a good education at Edinburgh, where he distinguished himself so much, that he was chosen to attend the son of the earl of Weemys at St. Andrew's. After this he went to Leyden, with the view to farther improvement, where he became acquainted with Poiret, one of the leaders of the Quietists, some of whose doctrines he imbibed. He

next went on a visit to the celebrated Fenelon, archbishop of Cambray, who converted him to the Roman Catholic religion, and Ramsay ever after this considered himself as the disciple of that excellent prelate. Upon his works he formed his literary taste, and he even adopted France for his country, and made use of its language in his writings. Here he obtained some poiss of honour and emolument, and was made knight of the order of St. Lazarus, whence he had the title of chevalier. His reputation caused him to be invited to Rome by the Pretender, in order that he might undertake the care and education of his children. This he accepted; but having found that little court so divided by faction, he quickly resigned his office, and returned to Paris. In the next year, 1725, he re-visited his native country, and resided some years with the duke of Argyle, employing himself in the composition of several works. After his return to France, he entered into the service of the prince of Turenne, duke of Bouillon. He died in 1743, at St. Germain-en-Laye, the retreat of the exiled Stuart family, at the age of 57. His principal writings were, "L'Histoire de la Vie et les Ouvrages de M. de Fenelon;" "Essai sur le Gouvernement Civil;" "Discours sur le Poeme Epique;" "Le Psychometre," being remarks on lord Shaftesbury's Characteristics; "L'Histoire du Marechal de Turenne;" and "Les Voyages de Cyrus." The last is that which is by much the best known, and it has been frequently printed in the French and English languages. Voltaire has styled it a feeble imitation of Telemachus; it is, however, written with elegance, but is tedious. Another of the chevalier's works was "A Dissertation on Free-Masonry," of which he was grand chancellor in France. In this he traces the origin of the institution to Palestine, in the time of the Crusades; and having found a great declension of the mystical ceremonies formerly practised, he strongly urged their renewal, and proposed a general assembly of the brotherhood of all nations to be held at Paris. Biog. Brit.

RAMSAY, in *Geography*. See RAMSEY.

RAMSAY Point, a cape on the S.E. coast of the island of Lewis. N. lat. 57° 44'. W. long. 6° 36'.

RAMSBURY, a village and parish in the hundred of Ramsbury, and county of Wilts, England, is situated about six miles to the eastward of the town of Marlborough, and 70 miles west by south from London. In the time of the Saxons it was a place of so much importance, as to be constituted the seat of the see, when Wiltshire was made a distinct bishopric by Plegmund, archbishop of Canterbury, in the year 909. Ramsbury church was then the cathedral church of the diocese, and continued to be so till bishop Herman prevailed upon king William the Conqueror to unite the bishoprics of Wiltshire and Sherborne, and fixed his episcopal seat at Old Sarum. The church, an ancient building, is divided into a nave, two aisles, and a chancel, with a massive square tower at its western extremity. In the chancel is a long stone, which tradition affirms to be the grave-stone of a giant; also an old altar tomb of Purbeck marble, without any inscription, and several monuments commemorative of the Joneses of Ramsbury manor, or park. This seat is now the property of sir Francis Burdett, bart. in right of his mother, second daughter of the late William Jones, esq. The house was designed in the Grecian style, by John Webb, nephew to Inigo Jones. The inclosures are extensive and well wooded, and are intersected by a branch of the river Kennet, which spreads itself out in the form of a lake, from the sides of which the grounds rise in easy, sloping lawns.

Littlecot park, the seat of major-general Edward Leybourne

bourne Popham, is situated partly in the parish of Ramf-bury, and partly in that of Chilton-Foliot. The house is a large ancient structure, built by one of the Darells, the former possessors of this domain, about the time when feudal warfare ceased, and defence was no longer an object in a country mansion. Notwithstanding many late alterations, the interior still preserves many of its original features. The great hall is very spacious, floored with stones, and lighted by large and very lofty windows. In it stands a large oaken table, at which the vassals of the domain were wont to feast at the expence of their lord. The remainder of the furniture is in a suitable style, particularly an arm-chair, which is said to have been used by sir John Popham, chief justice of the court of king's bench in the reigns of queen Elizabeth and king James I., who purchased the house and manor from the last of the Darells. There is also a curious instrument for the punishment and confinement of servants; by fastening their thumbs between two boards. The walls of the hall are decorated by numerous guns, carbines, pistols, doublets, &c. : and here are also two very fine candelabras, designed and executed by Mr. George Bullock of London, in an admirable style, as adapted to the age and character of the mansion. One of the bed-rooms is said to have been the scene of a singular and mysterious murder, the incidents attending which are recorded in a note to Scott's poem of Rokeby. In the gallery, which is about 110 feet in length, are portraits of judge Popham and Nell Gwyn; also a curious piece of needle-work, representing a large Roman tessellated pavement, which was discovered in the adjoining park in 1728, by Mr. George (steward to Edward Popham, esq.), who made a coloured drawing of it, and communicated the same to the Society of Antiquaries. This pavement consisted of two divisions, which appear to have formed the floor of a temple. The interior division was ornamented with the figure of Apollo playing on a harp; and in four surrounding compartments were four female figures riding on different animals, and designed to represent the Horæ, or Seasons. Exterior to the circle inclosing them were three other compartments, each displaying a face of the sun. From these circumstances the temple is supposed to have been dedicated to Apollo; but some emblems on its exterior division referring to Ceres and Neptune, it may, perhaps, be more properly esteemed a sort of pantheon. Another smaller Roman pavement, and a curious cup or patera of brass, were likewise discovered by Mr. George on Rudge-farm, adjoining the northern boundary of Littlecot park. The cup was adorned with foliage, and was inscribed with the names of five Roman stations. It was conjectured by Gale to have been a libation cup used at an annual feast instituted by the inhabitants of these towns.

Pickedfield, in this vicinity, is a government dépôt for the interior, established in 1803. It includes about forty acres of ground, on which are erected three magazines for powder, barracks for a detachment of the military, and various necessary houses and offices. *Beauties of England and Wales*, vol. xv. by John Britton, F.S.A.

RAMSDAL. See REMSDAL.

RAMSDEN, JESSE, in *Biography*, an eminent English mathematical and astronomical instrument-maker, the son of an inn-keeper at Salterhebble, near Halifax, in Yorkshire, where he was born in the year 1735. At nine years of age he was admitted into the Halifax free-school, where he acquired, during three years, the elements of classical learning; after which he was removed to the care of an uncle at Craven, by whom he was sent to a clergyman of the name of Hall, who had acquired much reputation by teaching at his school the mathematical sciences. Under this gentleman's instruc-

tions, young Ramsden became a proficient in geometry and algebra, and was advancing rapidly in these and other collateral branches of study when his father sent for him home, to apprentice him out with a clothier at Halifax. At the age of twenty he went to London, where he became clerk in a wholesale cloth warehouse. This situation he retained about two years and a half, when his inclination for the sciences revived so strongly, that he resolved to qualify himself for some business which should prove suitable to the bent of his mind. With this view he bound himself apprentice for four years to Mr. Burton in the Strand, who was esteemed one of the best workmen of his time in making thermometers and barometers, and in engraving and dividing mathematical instruments. After the expiration of his apprenticeship, he worked as journeyman with a person of the name of Cole, with whom he afterwards associated himself as partner. This connection did not last long, when Mr. Ramsden opened a workshop on his own account, in which he soon recommended himself to the employment of the principal mathematical instrument-makers in London. In the course of his business his repeated examination of the instruments which were sent him to be engraved or divided, led him to discover their defects, and his genius suggested to him the means of removing them, or of constructing better instruments. In order to put his plan into execution, he made himself master of the practical operations of the trade, and formed the design of examining every astronomical instrument in use, with the view of correcting those which, being founded on good principles, were faulty only in the construction, and of proscribing those which were defective in both these respects. About this time, by his marriage with Miss Dollond, he became possessed of a part of Mr. Dollond's patent for achromatic telescopes. In the year 1766, Mr. Ramsden opened a shop in the Haymarket, where he continued till 1774, when he removed to Piccadilly, where he remained till the time of his death. Before his settlement in the Haymarket, he had improved the sextant, and he had invented his celebrated dividing machine. (See the art. ENGINE.) Having spent ten years in bringing this machine to perfection, he obtained from the Board of Longitude a premium of 1000*l*. Mr. Ramsden constructed an instrument for dividing straight lines, which has been described in a former volume of the *New Cyclopædia*, and while he was employed on his dividing-machine he made great improvements in several other instruments. The THEODOLITE (see the article), before his time, consisted merely of a telescope, turning on a circle, divided at every three minutes, by means of a VERNIER, which see; but in the hands of Mr. Ramsden it became a new and perfect instrument, serving for measuring heights and distances, as well as taking angles. The largest and most perfect theodolite ever constructed was made by him for general Roy, for the purpose of measuring the series of triangles in England. Though this instrument is only of eighteen inches radius, its accuracy is so great as not to admit of an error of a single second. With this instrument general Roy measured the angle between the polar star and the sides of his triangles, in order to have the exact difference between the observations of Paris and Greenwich, which he found to be $9^{\circ} 20''$. Mr. Ramsden was a great improver of the barometer for measuring the height of mountains, which he could obtain to a degree of accuracy that was very surprising, and he caused to be engraved a table to accompany his barometers, which, without the trouble of calculation, gives the heights of places, according to the heights of the mercury, and even at different temperatures. He also pointed

pointed out a new method and apparatus adapted to the conveyance and support of the portable barometer. Mr. Ramsden made improvements on the electrical machine; and on manometers for measuring the density of the air: he invented an instrument for measuring inaccessible distances: assaying balances which turn with less than a ten thousandth part of the weight used: levels and a variety of other instruments. The pyrometer also exercised his talents, and on this occasion, as on all others, Mr. Ramsden shewed a sort of natural and almost intuitive sagacity in discovering the essential faults of an instrument, and in inventing the most simple and exact methods of correcting them. With respect to optics, he discovered a method of correcting, in a new and perfect manner, the aberration of sphericity and refrangibility in compound eye-glasses applied to all astronomical instruments. Opticians had imagined that the purpose might be accomplished by making the image of the object-glass fall between the two eye-glasses, which was attended with this great inconvenience, that the eye-glass could not be touched without deranging the line of collimation, and the value of the parts of the micrometer. To remedy this inconvenience, he set out from a simple experiment, *viz.* that the edges of an image observed through a prism are less coloured, according as the image is nearer the prism. This led him to attempt placing the two eye-glasses between the image of the object-glass and the eye, without failing to correct the two aberrations; which he did by changing the radii of the curves, and placing the glasses in a manner very different from that commonly employed. In the *Philosophical Transactions* for the year 1779, Mr. Ramsden has described a new reflecting object-glass micrometer; to the paper on this subject we refer our readers, and also to the article *MICROMETER* in this Dictionary. With this micrometer the diameters of the planets may be measured; it may be adapted to all kinds of achromatic telescopes; it may be brought near to, or removed from, the object-glass at pleasure, to render vision distinct; and it may be removed from the telescope, if the observer wish to use the latter without a micrometer. The high degree of merit to which Mr. Ramsden's many and important inventions were intitled, led his friends to propose him as a member of the Royal Society, and he was elected in the year 1786.

The *Equatorial* or *Transit* instrument (see the articles) received great improvements in the hands of Mr. Ramsden, who rejected the endless screw, which by pressing on the centre destroyed its precision; he placed the centre of gravity on the centre of the base, and caused all the movements to take place in every direction; he pointed out the means of rectifying the instrument in all its parts, and he applied to it a very ingenious small machine, for measuring or correcting the effect of refraction. The greatest equatorial instrument ever attempted, is that which he constructed for sir George Shuckburg, on which he employed several years, and of which we have given a description and figure. Mr. Ramsden's meridian telescopes which he made for Blenheim, Mannheim, Dublin, Paris, and Gotha, are also remarkable for the excellence of their object-glasses. With that of Dublin, Mr. Usher observed stars of the fourth magnitude in the open day, and those of the third very near their conjunction with the sun. These telescopes are eight feet in length. There is a five-foot one at the observatory at Palermo. Mr. Ramsden made great improvements in the mural quadrant, of which a full account will be found in the article *CIRCLE*, to which we refer our readers for much valuable information on the subject of astronomical instruments. Having in various parts of our work entered into the nature

of Mr. Ramsden's improvements and inventions, it is unnecessary to repeat here what has already been fully explained.

The field in which the inventive genius and superior talents of Mr. Ramsden were exercised, was, as we have seen, very extensive. In order that every part of his instruments might be fabricated under his own inspection, he collected in his workshops men of every branch of trade necessary for their construction. So important did he consider the principle of division of labour, that he always confined the same workmen to the same branch, and by that means arrived at the greatest correctness and nicety in executing it. Notwithstanding the great perfection of his instruments, which ought to have secured to Mr. Ramsden a large fortune, he sold them cheaper than any other artist in London, sometimes even one-third below the usual price. Such was the demand for them, from almost all parts of the world, that though he employed sixty men, he was unable to execute all the orders which he received. His great attention to business injured his health, and hastened his death. He died at Brighton, where he had been for the benefit of the sea-air, November 5, 1800, in the sixty-sixth year of his age. He had been elected a member of the Imperial Academy of Sciences at Petersburg in 1794, and in the following year he was presented with the gold medal, adjudged by the Royal Society to persons distinguished for their scientific talents.

Mr. Ramsden was by nature endowed with uncommonly strong reasoning powers, and a most accurate and retentive memory, but, at the same time, with such a quickness of penetration, that he could, as it were, with a single glance, view in every light the subject on which he thought, and adopt the most advantageous mode of considering it. He possessed, in an exquisite degree, that quality of mind which is emphatically styled elegance, which in the abstract sciences leads to clearness, simplicity, and precision, as in the fine arts and literature, it gives the last polish to genius, and is more generally known by the appellation of taste. In his habits he was temperate to abstemiousness, satisfied with small quantities of food, and a small portion of sleep. Unacquainted with dissipation or amusement, and giving but little time even to the society of his friends, the whole of those hours which he could spare from the duties of his profession, he devoted either to further improvements in his instruments, or to the perusal of books of science, particularly those mathematical works of the sublime writers which had any connection with the subject of his own pursuits. Mr. Ramsden's only relaxation from almost constant and severe studies, was the occasional perusal of the best authors, both in prose and verse; and when it is recollected that at an advanced age he made himself so completely master of the French language, as to read with peculiar pleasure the works of Boileau and Moliere, no one can believe that he mis-spent even his hours of amusement. Short and temperate as were his repasts, a book or a pen was the constant companion of his meals; and when illness broke his sleep, a lamp and a book were ever in readiness to beguile the sense of pain, and make bodily sickness minister to the progress of his mind. He was well skilled in the abstruse parts of mathematics, and conversant with the best writers on the sciences; and such was his manual dexterity, that there was not one tool in any of the numerous branches of his profession which he could not use with a degree of perfection equal to that of the very best workman in that particular branch, and he could have begun and finished every single part of his most complicated instruments. For this article we are chiefly indebted to a very elaborate and excellent original memoir in the 8th vol. of the *Gen. Biog.*

RAMSDORF, in *Geography*, a town of Saxony, in the bishopric of Naumburg; three miles N.E. of Zeitz.

RAMSEA, or **RAMSEY**, a market and sea-port town in the parish of Kirk-Maughold, Isle of Man, Great Britain, is situated at the distance of fourteen miles north-east from Douglas, the chief town in the island. Anciently this place was of considerable note, but it is now comparatively decayed. The bay upon which it is built might be rendered capable of affording anchorage and security to very large vessels, but it is much choked up with sand at the entrance to the harbour, and is therefore little frequented, though protected by a fort, mounted with several pieces of cannon. At the extremity of the pier is a light-house, the lower division of which is used as an occasional prison. The chief article of export from Ramsea is grain, the produce of the vicinity which is among the best cultivated districts in the British islands. Several boats, with good accommodation for passengers, sail weekly from hence to Liverpool, and to Whitehaven; but what gives most importance to the town at present is, the circumstance of its being the seat of the courts of justice for the northern district. According to the population returns of 1792, (the last returns made for the island,) Ramsea contained 1100 inhabitants, but their number is now probably increased to 1400.

In the parish of Kirk-Andreas, to the north of Ramsea, are several curiosities, particularly an ancient intrenchment at Ballachurry, which occupies a small isolated eminence, in a very level tract of country. This earthen work is of a square form, and is surrounded by a wide and deep fosse and rampart, flanked at each angle by a very noble bastion. The area within is much sunk below the level of the works, which are in a state of excellent preservation, and might easily be rendered effectual for the purposes of modern warfare. This district abounds with sepulchral tumuli; some of them environed by large upright stones. Several of these barrows were opened, about twenty years ago, by Mr. Chaloner, and found to contain simple urn interments. In the church-yard here stands a square pillar of stone, bearing a Runic inscription, which is thus translated by Mr. Beauford of Athy, in Ireland. "The son of Ulf of the Swedri (Swedes) erected this cross to the warrior Afterarin, the son of Cunnú." Another inscription on a similar monument is to be seen in the neighbouring church-yard of Kirk-Michael, which is an extensive village, pleasantly situated near the sea. In this parish is a monument of the cairn description, composed of small stones heaped together. It is called Cairn-Viael, but nothing is known respecting its origin, and peculiar appropriation. About a mile from hence is Bishop's Court, the usual residence of the bishops of Man. The palace was nearly rebuilt about twenty years ago. It is an elegant and convenient mansion, surrounded by agreeable gardens and pleasure grounds. Beauties of England and Wales, vol. iii. By John Britton and E. W. Brayley, 1802. Carlisle's Topographical Dictionary of Scotland, 2 vols. 4to. 1813.

RAMSEIL, a town of Hindoostan, in Baglana; ten miles N. of Nussick.

RAMSELE, a town of Sweden, in Angermanland; 70 miles N.W. of Hernösand.

RAMSENTHAL, a town of Germany, in the principality of Culmbach; four miles N. of Bayreuth.

RAMSEY, a market-town in the hundred of Huntingstone, and county of Huntingdon, England, is situated on the banks of a small river, to which it gives name, at the distance of ten miles N.N.E. from the town of Huntingdon, and sixty-eight miles N.W. from London. It is particularly

celebrated in history for its abbey, which was founded by the renowned duke Ailwin, at the persuasion of Oswald, bishop of Worcester, in the year 969. The buildings were completed in the course of five years, at the expiration of which, the monastery was dedicated to the Holy Virgin and St. Benedict, and filled with monks of the Benedictine order. Ailwin gave considerable possessions to his new establishment, and procured for it many valuable privileges from king Edgar. This monarch confirmed to the monks all their lands, and gave them the right of impressing the image of his royal person upon their seals. Several succeeding princes, and many private persons of rank and opulence, contributed to enrich the abbey, which afterwards became one of those distinguished by the title "mitred." Its abbots were consequently privileged to sit in parliament among the peers, and enjoyed all the other accustomed rights of mitred abbots. Many of the monks were men of pre-eminent genius and learning, and were especially noted for their proficiency in the Hebrew language. The library belonging to the monastery was extensive, and contained many books written in that tongue by its inmates. At the era of the dissolution, its annual revenues were estimated, according to Dugdale, at 1716*l.* 12*s.* 4*d.*; but Speed, on the authority of sir Robert Cotton, states their amount at 1987*l.* 15*s.* 3*d.* Some years after that event, the demesnes and lands of the abbey, with several lakes belonging to it within this parish, were granted to sir Richard Cromwell, ancestor to the Protector.

Ramsey consists chiefly of one long street, with another branching off from it, in a northern direction. The abbey stood at the upper end of the town, towards the south, near the manor-house, a large and elegant mansion, built out of its ruins. The only portion of the old buildings standing is a gateway, which appears, from the style of its architecture, to have been erected about the reign of Henry VI. Since the destruction of the abbey, it was for some time used as a prison. At a short distance from this relic stands the present church of Ramsey, a spacious and handsome edifice, consisting of a nave, chancel, and aisles, with an embattled tower at the west end. The nave is separated from the aisles by seven large and well-proportioned arches on each side, springing from clustered columns; and from the chancel by a still larger arch, with a screen richly carved in wood crossing the lower part. The windows are large, and, as is apparent from many fragments remaining, have once been filled with stained glass, exhibiting figures of angels, crowned heads, &c. Several branches of the Cromwell family were buried in this church, but there are no monuments to their memory. In this town is a free-school, founded and endowed in 1663, under a decree of chancery, but the establishment has been much neglected; also a charity-school for girls, instituted about a century ago by John Dryden, esq. who bequeathed 16,000*l.* for various charitable purposes. The market day here is Wednesday, weekly, and there is an annual fair on the 22d of July. Ramsey suffered greatly from the plague in the year 1665—6, that dreadful distemper having been introduced by the accident of major William Cromwell wearing a coat, the cloth of which had been brought from the metropolis. The number of deaths amounted to 400 within one month. This town likewise sustained much injury from fire in 1731; but the damage was soon repaired. According to the population returns of 1811, the parish contains 484 houses, and 2390 inhabitants.

The country around Ramsey is extremely marshy, and hence is intersected by numerous ditches, or drains to carry off the water. To the north-west about two miles, is a lake

lake called Ugg-Mere, and at the distance of a mile further northwards, is a still larger collection of water, named Whittlesea-Mere; and there is a third to the north-east of the town, styled Ramsey-Mere. All these lakes abound with fish of various kinds. Running northwards from that last mentioned, is a high causeway, called King's-delf, or dyke, which is mentioned in record as early as the reign of king Edgar. It is commonly confounded with Cnuts-delf, or Swerdes-delf, called also Steeds-dyke, which forms the boundary of this county with Cambridgeshire. Beauties of England and Wales, vol. vii. by E. W. Brayley, 1808.

RAMSEY, *Isle of*, an island in the ewinwd of Mynyw, cantref of Pybidiog, (now called the hundred of Dewiland,) and county of Pembroke, South Wales, is situated in the Irish sea, opposite to the promontory called St. David's Head, from which it is about three miles distant. This island is nearly four miles in length, and exceeds one mile in breadth. Throughout its whole extent the surface is lofty, and at each extremity a mountain shoots to a great height above the general level, giving the island a very romantic appearance. From the shore the ascent is bold and precipitous on all sides, and at one spot, called the Choir, the rocks assume an amphitheatrical form, and rise perpendicularly to a stupendous elevation. Ramsey was formerly cultivated, but is now chiefly appropriated as pasturage for sheep and horses. It is abundantly supplied with fresh water, for which benefit tradition records that the island is indebted to Justinian, a devotee from Brittany, who settled here in the fifth century. Here were anciently two chapels, one sacred to Devanus, or Devynoy, and the other to Justinian above-mentioned, who was murdered by his servants, and buried on the spot where the chapel was raised to his memory. Ramsey belongs to the bishop of St. David's, as do likewise several smaller islands in its vicinity, of which seven are distinguished by the appellation of the Bishop and his Clerks. Innumerable flocks of birds frequent and breed on these islands, and, among other kinds, the celebrated hunting falcon is frequently seen. An Historical Tour through Pembroke-shire, by Richard Fenton, F. S. A. Carlisle's Topographical Dictionary of Wales, 4to. 1813.

RAMSGATE, a member of the town and port of Sandwich, in the upper half hundred of Ringlow, Isle of Thanet, lathe of St. Auguline, and county of Kent, England, is situated on the shore of the German ocean, at the distance of 72 miles S.E. from London. Like Margate, it was formerly only a small fishing hamlet, consisting of a few mean, and indifferently built, houses. In the reign of queen Elizabeth, indeed, it was returned in the maritime survey as having no more than seventy sailors belonging to it, and these chiefly fishermen. What first gave it importance was the extension of the Russian trade after the revolution in 1688; but it is chiefly indebted for its present consequence to the improvements made in the harbour since the middle of the last century; for although a pier for shipping existed here, at least from the time of Henry VIII., yet it was altogether inadequate to afford security to the numerous ships driven on the coast in tempestuous weather. Parliament was therefore induced, at the petition of the merchants and ship-owners who were interested, to pass an act, ordering a proper harbour to be formed for the reception "of ships of, and under, 300 tons burthen." Under this act trustees were, as usual, appointed; and in the year 1749-50, the work was begun, according to designs by William Ockenden, esq., and captain Robert Brooke. So many difficulties, however, occurred in carrying it into execution, that the harbour was not completed till the year 1791. The sum which the whole cost exceeded 600,000*l.*; but that amount is trivial compared to

the great benefit derived from it to our shipping interest. The area of the harbour is nearly circular, and comprehends about forty-six acres. The piers, basin, &c. are constructed of Purbeck and Portland stone, principally the latter. The entire length of the east pier, including its flexures, or angles, amounts to nearly 2000 feet; that of the west pier is about 1500 feet; the width of the entrance is 240 feet. The general breadth of the piers is twenty-six feet, including a strong parapet, which defends the outer sides next the sea. What is called the East Channel, is formed by the passage between the east pier and a large bank of sand which nearly crosses the harbour as far as the basin, and is of considerable use for ships to bring up upon, in heavy gales, when driven into the harbour without anchors or cables. Near the north end of the west pier is a massive frame work of timber, and a staircase, called Jacob's ladder, forming a communication from the top to the bottom of the cliff. The east pier is a favourite promenade in summer, and is much admired for the peculiarly fine sea-views which it commands.

In judicial proceedings, Ramsgate is technically denoted the *village* of Ramsgate. It is in the parish of St. Lawrence, and is assailed to that church, but it maintains its own poor separately, and the inhabitants have the right of choosing one churchwarden from among themselves. As an ancient member of the town of Sandwich, it is in subjection to the justices of that place. The mayor of Sandwich appoints a deputy, or constable, here, and the inhabitants are allotted by the commissioners of that borough, what proportion of land tax they shall pay. A small annual sum is also paid out of the duties collected at Ramsgate harbour towards the support of Sandwich haven. The influx of visitors to this town of late years has greatly increased, and has consequently occasioned a considerable extension of its buildings. A market has been established for several years; and the streets are paved, lighted, and watched, under the authority of an act of parliament passed in 1785. Here is a spacious chapel of ease, and several meeting-houses for dissenters of different denominations. The accommodation for the summer residents are similar to those at Margate, though perhaps less numerous, and scarcely so splendid. The assembly room and tavern is a spacious building adjoining the harbour. It is elegantly fitted up, and contains convenient tea and card-rooms, a billiard-room, and a coffee-room. Here are likewise several good inns, with bathing-rooms, libraries, boarding-houses, &c. The bathing-place is a fine sandy shore, beneath the cliffs to the south of the pier: the machines are similar to those at Margate, *viz.* a sort of close caravan, having a door and small flight of steps behind, by which the bathers descend to the water, and are concealed from view by a pendant covering of canvas. Within the last forty years the population of Ramsgate has increased almost in the ratio of three to one. In 1801, according to the parliamentary returns, it contained 726 houses, and 3110 inhabitants; but, in 1811, the former were returned as amounting to 919, and the latter to 4221.

Half a mile westward from Ramsgate is Ellington, anciently a seat of a family of the same name, who, towards the end of the reign of Edward IV., were succeeded by the Thatchers, another ancient Kentish family, from whom it passed to the Sparkings. St. Lawrence is a large village, situated on the brow of the hill overlooking Ramsgate; the houses forming a long winding street along the high road to London. The church here is a spacious edifice, consisting of a nave, aisles, and three chancels, with a square tower, supported upon four massive columns, between the nave and principal chancel. The tower, and part of the body, are of Norman architecture, and on the outside of the former, by way of decoration,

decoration, appear ranges of small semicircular arches springing from plain octagon pillars; the capitals of the piers which support it also displaying some curious sculpture. Among the sepulchral memorials here, are several in memory of the Sparkings of Ellington, and the Mansions of Mansfont-court, an ancient mansion, situated about two miles to the north-west of St. Lawrence, now converted into a farmhouse. Minster, another village in this vicinity, derives its name from a church or nunnery founded here in 670, by Domneva, wife to Merwald, son of Penda, king of Mercia. In the early part of life she had been left, with her sister Ermengitha, and her brothers Ethelred and Ethelbright, under the guardianship of her uncle Egbert, king of Kent, who murdered the princes, and in expiation of the crime offered to give to Domneva whatever she should ask. The lady demanded as much land as a tame deer would run over at one course, to endow a monastery, which was accordingly granted to her. When her buildings were raised, she placed therein 70 nuns, and, taking the veil herself, became their first abbess. She was succeeded by her daughter St. Mildred, from whom the abbey afterwards was denominated St. Mildred's abbey. This establishment was frequently plundered by the Danes during the eighth and ninth centuries, and at length was set fire to, and totally destroyed, together with the nuns, the clergy, and many of the people who had fled hither for sanctuary. The possessions of this abbey were subsequently granted to the monks of the monastery of St. Augustine, in Canterbury, by king Canute, and by them the body of St. Mildred was removed to their own abbey. The parish church of Minster, which occupies the site of the ancient nunnery, appears to have been originally founded about the time of the conquest, but it has undergone many alterations, and consequently exhibits various styles of architecture. The nave, which is the oldest portion of it, is divided from the aisles by semi-circular arches springing from short massive columns. The chancel is vaulted with stone, as is likewise part of the transept. Beauties of England and Wales, vol. viii. by E. W. Brayley. History of Kent, by Edward Hasted, esq., 8vo. edit. vol. x. Lewis's History of the Isle of Thanet, 4to.

RAMSHAGUR, a town of Bengal; 5 miles S. of Dinagepour.

RAMSHYDA, a town of Sweden, in the province of Nericia; 28 miles N. of Orebro.

RAMSIN, a town of Saxony; 3 miles W. of Bitterfeld.

RAMSONS, in *Botany*, a name given to the broad-leaved wild allium. See **ALLIUM**.

RAMSTADT, in *Geography*, a town of Hesse-Darmstadt; 3 miles S.E. of Darmstadt.

RAMTCHIEU, a lake of Thibet, formed by three separate rivulets, and surrounded with an incrustation, of a white colour and saltish taste. This substance is collected and employed for cleansing and washing woollen and cotton cloths, as a substitute for soap, to which the inhabitants of the adjacent country are utter strangers. Near this lake is a large monastery, called Lubchea Goomba, seated amidst rocks, which protrude their bases into the lake, and are bordered with a white foam, produced by its agitated waves. The banks of this lake are perforated with innumerable burrows of a small animal, to which they give the name of rat, larger than a musk rat, of a cinereous grey, without a tail, conceived by Mr. Turner to have been the daman of Israel and Egypt, or the Schaphan of the Hebrews. The lake is also frequented by great abundance of water-fowl, wild geese, ducks, teal, and storks, which, on the approach of winter, take their flight to milder regions. Prodigious

numbers of saurasses, the largest species of the crane kind, are here seen at certain seasons of the year, so that any quantity of eggs may be collected. The lake gradually narrows, and from its northern edge sends off a small brook; and at the other extremity it discharges itself into a much larger lake. This lake, it is said, is held in high respect by the inhabitants of Bootan, whose superstition leads them to consider the increase or decrease of its waters as portentous of good or evil to their nation. They fancy it to be a favourite haunt of their chief deities. Turner's Thibet, p. 212, &c.

RAMTEAK, or **RAMTEGH**, a town of Hindoostan, in the circar of Goondwana, held sacred by the Hindoos, who pretend that Ram collected his army here, prior to his expedition against Rawun at Lanka, or Ceylon. The Hindoos believe all the Europeans to have descended from Rawun, and Ceylon to be an immense mountain of gold invisible to them. Near the town is a temple, in which they offer up their sacrifices and devotions; 15 miles N.E. of Nagpour. N. lat. 21° 23'. E. long. 79° 57'.

RAMTRUT, in *Mythology*, the name of a deity worshipped by the Kanazins, a people of Hindoostan, where he has a celebrated temple, at Onor. The characters under which he is represented more resemble those of a monkey than of a man.

RAMULOSE LEAF, in *Botany*. See **LEAF**.

RAMUNDA, or **ROMLA BODA**, in *Geography*, a town of Sweden, in Nericia.

RAMURAH. See **RAMGUR**.

RAMUS, **PETER**, in *Biography*. See **RAMISTS**.

RAMUS, in *Anatomy*. This word, signifying *branch*, and the term *ramification*, are used in describing the arteries, veins, and nerves, the divisions and subdivisions of which bear some analogy to the branching of a tree. In the same way we speak of *trunks* of arteries, &c. and describe them as *branching out*.

RAMUS, in the *Anatomy of Plants*, a name given to the first or lateral branches, which go off from the petiole, or middle rib of a leaf. The subdivisions of these are called *furculi*; and the final divisions of these into the most minute of all, are by some called *capillamenta*: but in general, both these kinds are comprehended under the name of *furculus*.

RAMUSIO, or **RANNUSIO**, **GIAMBATISTA**, in *Biography*, an early collector of voyages and travels, the son of Paolo, an eminent lawyer, descended from a learned and distinguished family of Venetian citizens, was born at Venice in 1485. He was in early life deputed by the state upon public business to Switzerland, Rome, and France; and in the latter country he so much ingratiated himself with Lewis XII., that he was by him caused to travel through almost the whole of his kingdom. As a reward for his services, he was made secretary of the council of ten at Venice, which post he at length resigned; and returning to Padua, employed himself in compiling his great work, "*Raccolta delle Navigazioni e de Viaggi*," which was published at different periods between the years 1554 and 1559, in three volumes folio. He had prepared a fourth volume, which was burnt at the printer's. Ramusio died at Padua in 1557; of course, a part of his work was given to the world after his decease. Ramusio was author of a treatise "*De Nili Incremento*." He was a man of great learning, and was extremely conversant in history, geography, and the ancient languages: he had some knowledge in astronomy, and held a correspondence with many learned men and well informed persons, both in Italy and Spain. It was by their assistance, and at the desire of Fracastoro, that he composed

the work already mentioned. This work was a collection of all the voyages and travels that had hitherto been published; in which he gave translations of those in foreign languages; and he prefixed dissertations, in which he diligently examined the pretensions of different authors, comparing them with one another.

RAN, in our *Old Writers*, is used for open and public robbery, so manifest that it cannot be denied. "Ran dicitur aperta rapina quæ negari non potest." Lamb. 125. Leg. Canut. cap. 58. Hence it is to this day vulgarly said of one who takes the goods of another injuriously and violently, that he has taken or snatched all he could *rap* and *ran*.

RAN, twenty cords of twine, wound on a reel; and every cord so parted by a knot, as to be easily separated.

RANA, in *Geography*, a town of Austria; 12 miles S. of Aigen.—Also, a town of Austria; 13 miles S.S.W. of Zwettl.

RANA, or *Oranoi*, one of the Sandwich islands, in the North Pacific ocean, situated about three leagues from Mowee and Morotoi, and lying to the S.W. of the passage between these islands. The country to the south is high and craggy; but the other parts of the island had a better aspect, and appeared to be well inhabited. It produces very few plantains, and bread-fruit trees; but abounds in roots, such as yams, sweet potatoes, and tarrow. The number of inhabitants is estimated at 20,400. Its S. point is in lat. 20° 46'. E. long. 203° 8'. Cook's Third Voyage, vol. iii.

RANA, in *Surgery*. See RANULA.

RANA, in *Zoology*, the frog, a genus of the class Amphibia, of the division Reptiles, of which the generic character is: Body four-footed, naked; it generally has no tail, the hind legs are longer than the fore. This genus differs from the *Lacerta* (see the art. LIZARD), in having a shorter body, broader, thicker head, and in general no tail. The animals of it feed on insects; they are full grown about the fourth year, and seldom live beyond the twelfth. Their fore-feet are mostly cleft, having four toes: their hind-feet are palmate and five-toed; they are extremely salacious, sticking to the female for days and weeks: the tadpole is excluded from the egg without feet, but with a tail resembling a fish's, which drops off as the legs are protruded; in this state they have likewise a sort of gills and lungs, and many have a small tube on the lower lip, by which they can affix themselves to other bodies; near the left eye is a vesicle, from which they discharge water: in breeding time, the fore-thumb of the male is warty: toads, as we all know, are filthy in their aspect, and live in damp, obscure, dark places, and crawl out only by night: their eggs are in a long chain: frogs are more active, and more about by day; these lay their eggs in a confused mass.

Dr. Shaw, in his entertaining and instructive *Zoology*, says this genus may be divided into three sections; viz. 1. Frogs, commonly called *Rana*, with light active bodies, and which leap when disturbed. 2. Slender-limbed frogs, *Hyla*, *Calamita*, or *Rana arborea*, viz. such as have light bodies, very slender limbs, and toes terminating in flat, circularly expanded tips, enabling the animal to adhere at pleasure to the surface even of the smoothest bodies. Several of this division actually reside on trees, adhering by their toes to the lower surfaces of the leaves and branches. 3. Toads, *Bufones*, or such as have heavy bodies, short thick limbs, and which rather crawl than leap when disturbed.

Gmelin has given a different arrangement, which, according to our usual custom, we shall follow in this ar-

ticle. He divides the genus into three sections, viz. A, those with warty and puffed up bodies; and short legs: these are *toads*. B, those with bodies rather oblong, smooth and with longer legs: these are *frogs*, properly so called. And C, whose hind feet are very long; and whose claws are lenticulate. Dr. Shaw enumerates more than fifty species, but Gmelin describes only thirty-six.

Section A.—*Body warty, puffed up: shorter Legs.*

Species.

Pipa; Surinam Toad. The toes of the fore-feet of this species are unarmed, four-cleft; those of the hind-feet are clawed and palmate.

This hideous and deformed animal inhabits the waters of Guiana, and is actually eaten by the natives. The male, after the exclusion of the eggs, collects the mass together, and smears it over the back of the females with its paws, where they are received into small cells, impregnated by the males and closed up; after some time the perfect young are excluded from those hollow tubercles on the back of the female.

The size of the *Pipa* considerably exceeds that of the common toad; the head is flat, broad, and very short; the beak is spatula-shaped; the eyes very small and remote; neck very short, wrinkled; the body is orbicular, flat, with a hard cartilaginous skin; the fore toes are round, and the hind ones very long, connected by an undivided membrane. This species was first made known to the Europeans about the latter end of the 17th century.

Musica; Musical Toad. The specific character of this is, that it has gibbous shoulders that are dotted; the body is varied with lurid and brown; the fore-feet are cleft, and the hind-feet are subpalmate and five-toed, with scarcely any claws. It inhabits the fresh waters of Surinam: it is larger than the common toad: in the evening, and during the whole night, it keeps up a continual musical kind of croaking; hence it takes its name.

**Bufo*; Common Toad. Body lurid and brown: of this animal there are three varieties, as follows: the first has its back of an olive colour; and an unequal yellowish-red band down the side: the body of the second is marked with confluent green spots and warts on the spots of the same colour, those of the intervals red, the spaces between bicoloured. The third is particularly distinguished for its size, being much less than the others. This of all the European toads seems to be the most universally known. It is found in shady places, in gardens, woods, and fields, and frequently makes its way into cellars, or any obscure recesses in which it may occasionally conceal itself, and where it may find a supply of food, or a security from too great a degree of cold. In the early part of spring, like others of this genus, it retires to the waters, where it continues during the breeding season, and deposits its ova or spawn in the form of double necklace-like chains or strings of beautifully transparent gluten, and of the length of three or four feet, in each of which are disposed the ova in a continued double series throughout the whole length, having the appearance of so many small jet-black globules or beads; being in reality no other than the tadpoles or larvæ convoluted into a globular form, and waiting for the period of their evolution, or hatching, which takes place in the space of about fourteen or fifteen days, when they break from the surrounding gluten, and like the tadpoles of frogs, swim about in the water, and are nourished by various animalcules, gluten, leaves of water-plants, &c. &c. till, having arrived at their full growth, the legs are formed, the tail

gradually becomes obliterated, and the animals leave the water, and betake themselves to the surface of the ground. This generally happens early in the autumn, at which period it is not uncommon to find such numbers of the young animals in some particular places, that their appearance has frequently given rise to the vulgar idea of their having been showered from the clouds.

The toad is an animal too well known to require any very particular description of its form. It may be necessary to observe, that it is always covered by tubercles, or elevations on the skin, of larger or smaller size in different individuals, and that the general colour of the animal is an obscure brown above, much paler and irregularly spotted beneath. The toad, however, is occasionally found of an olive cast, with darker variegations; and in some specimens, more especially in the earliest part of summer, the shoulders and limbs are marked with reddish spots, while a tinge of yellow often pervades the under parts both of the limbs and body.

The toad arrives at a considerable age; its general term of life being supposed to extend to fifteen, or even twenty years; and Mr. Pennant, in his British Zoology, gives us a curious account, communicated by Mr. Arscott, of Teholt, in Devonshire, of a toad's having lived, in a kind of domestic state, for the space of more than forty years, and of having been, in a great degree, tamed, or reclaimed from its natural thyness or desire of concealment; since it would always regularly come out of its hole at the approach of its master, &c. in order to be fed. It grew to a very large size, and was considered as so singular a curiosity, that even ladies, laying aside their usual aversion and prejudices, requested to see the favourite toad. It was, therefore, often brought to table, and fed with various insects, which it seized with great avidity, and without seeming to be embarrassed by the presence of company. This extraordinary animal generally resided in a hole beneath the steps of the house door, fronting the garden; and might probably have survived many years longer, had it not been severely wounded by a raven, which seized it before it could take refuge in its hole, and notwithstanding it was liberated from its captor, it never again enjoyed its usual health, though it continued to live above a year after the accident happened.

The toad is looked upon with great aversion by the major part of mankind, and it must be confessed, that its appearance is disgusting, yet the eyes are remarkably beautiful, being surrounded by a reddish gold-coloured iris, the pupil, when in a state of contraction, appearing transverse.

We shall conclude the history of this animal, with mentioning the very extraordinary circumstance of its having been occasionally discovered inclosed, or imbedded, without any visible outlet, or even any passage for air, in the substance of wood, and even in that of stone or blocks of marble. "For my own part," says Dr. Shaw, "I have no hesitation in avowing a very high degree of scepticism as to these supposed facts, and in expressing my suspicions that proper attention, in such cases, was not paid to the real situation of the animal. That a toad may have occasionally latibulized in some part of a tree, and have been in some degree overtaken or inclosed by the growth of the wood, so as to be obliged to continue in that situation, without being able to effect its escape, may perhaps be granted: but it would probably continue to live so long only as there remained a passage for air, and for the ingress of insects, &c. on which it might occasionally feed: but that it should be completely blocked up in any kind of stone or marble, without either food or air, appears entirely incredible, and the

general run of such accounts must be received with a great many grains of allowance for the natural love of the marvellous, the surprise excited by the sudden appearance of the animal in an unsuspected place, and the consequent neglect of minute attention at the moment, to the surrounding parts of the spot where it was discovered."

* **RUBETA**; the Natter Jack. Of this the vent is obtuse; and it has a yellow line on the back; the body beneath is spotted with black, but above it is of a dirty yellow, clouded with brown, and covered with porous pimples of unequal sizes. This species frequents dry and sandy places, and is found on Putney Common, and near Reevesby-Abbey in Lincolnshire, where it derives its trivial name. It never leaps, neither does it crawl, with the slow pace of a toad, but its motion is more like running. Several are frequently found together, and like others of the genus they appear in the evening.

GIBBOSA; Gibbous Toad. Body oval, convex, with a longitudinal cinereous dentate band. A variety has its back marbled with red and yellowish-ash; the belly is yellow, spotted with black. The first is found in divers parts of India, the second at Surinam.

BOMBINA; Laughing Toad. Belly orange, spotted with sky-blue; the pupil is triangular. Gmelin gives three varieties of this species; viz. 1. That which is distinguished with a black belly, marked with clear white spots and points. 2. One which is brown with white spots; the sides and round the joints are red. 3. One which is distinguished for its loud sonorous voice. It is found in the fenny parts of Germany and Helvetia; leaps like a frog; emits a clear sound like a man laughing: it a good deal resembles the common toad, but is small, black, and every where rough, with dots on the upper part, and variegated beneath, with transverse wrinkles under the neck.

SALSA; Salt Toad. Above of a dirty olive colour, but beneath it is white, spotted with black. This species is found in the stagnant waters of Berchtesgaden, and is less than the *R. arborea*, hereafter to be noticed; it avoids the light, is inodorous, and emits no liquid from its minute perforated warts: the legs are marked with brown bands, beneath it is yellow.

VENTRICOSA; Tumid Toad. The mouth of this is femi-ovate, and the throat ovate. A variety is marked with pale white pustules. It is found in South America, and in some parts of India. The body is brown and orbicular; the tubercles on the top of the neck longitudinally disposed; the back has three longitudinal wrinkles; the flanks are tumid and dilated.

MARINA; Marine Toad. Shoulders tumid; eye-lids warty, conchate; the hind feet are subpalmate: there is a variety, which is spotted with brown; beneath it is shaded with livid, the neck and shoulders are spotted with grey. This is found in various parts of America, and is more than six inches long. Its body is yellowish-grey, with a few rather tawny spots: the warts are distinguished with an elevated bay spot in the middle: the protuberances of the shoulders are oval, smooth, and porous; the vent is surrounded with wrinkled radii; the hind toes are connected only as far as the first joint, the last joint is fringed with a bay membrane.

BRASILENSIS; Brasil Toad. Yellowish-ash, with red waved spots, beneath smooth.

ARUNCO; Chili Toad. All the feet of this species are palmate. It inhabits, as its name imports, the waters of Chili: in its size it resembles the *R. temporaria* described below: on the hind toes there is a slight appearance of claws.

RANA.

LUTEA; Yellow Toad. The body of this is yellow; all the feet are subpalmate. This is also found in Chili, and much resembles, in its habits, the *R. esculenta*, but is much less; the last joints of the toes are not connected.

MARGARITIFERA; Pearled Toad. Body brown-red, sprinkled with pale red spots.

CORNUTA; the Horned Toad. This takes its specific name from the circumstance of having its eye-lids horned. It inhabits Virginia and Surinam, and of the whole tribe it is the most deformed. It is said, indeed, to surpass all animals in ugliness. It is thus described: the head is large, and rounded before; the mouth is excessively large; the eye-lids are soft, mucronate, trifid at the point; the eyes are seated in the middle; the body is of a greenish-brown, with broad longitudinal whitish stripes on the back; the legs are transversely fasciate with brown: when full grown, the back, the thighs, and vent, are spiny.

SITIBUNDA; Desert Toad. The specific character is, that above it is ashy-glaucous, varied with blackish-green spots, beneath of a dirty white; the hind feet are semi-palmate, with the appearance of seven toes. It inhabits the dry deserts near the Ural, sometimes hides itself in holes, and crawls out in the evening; it resembles the common toad, but is somewhat larger.

VESPERTINA; Siberian Toad. This has a transverse spot between the eyes, forked behind, and other spots running obliquely from the eyes to the nose; the body above is cinereous, with longitudinal subconfluent brown spots, varied with different shades of green; beneath it is dashed with a whitish-ash. As its trivial name imports, it inhabits Siberia, and is about the size of a common toad; it leaps slowly: the head is short; the body above is sprinkled with subwart papillæ.

RIDIBUNDA; Jocular Toad. Body brown, spotted above with cinereous; the dorsal line is yellow, or greenish; beneath it is smooth, whitish; haunches brown, spotted with milk-white. The head of this species is broad; the upper eye-lid is convex, sprinkled with pores; the apertures of the ears are flat; the back is porous; the sides are marked with obsolete warts; the fore thumb is divaricate, thick at the base; the next toe shorter than the rest; the hind limb subfasciate; the hind feet have a callus within, resembling a sixth toe; the toes have a wart beneath, near the joints.

This species is found in great numbers near the rivers which empty themselves into the Caspian sea; it never ventures on the dry land; it is very large, and frequently weighs more than half a pound: it resembles the *R. temporaria*, but is broader and shorter; its voice in the evening is like that of a man laughing.

VARIABILIS; Changeable Toad. Colour variable; back and sides gibbous; warts yellowish in the centre; it is very small on the middle of the back, and larger on the most prominent part of the flanks. It inhabits the shady places in Germany, and is only about two inches long: in its habits, it holds an intermediate place between the toad and frog; when full awake its body is white, with green spots; in the heat of the sun it is entirely cinereous; when asleep, the spots are only cinereous, and when torpid the body has a flesh-coloured cast.

The head is rounded, and the mouth without teeth; the margin of the upper jaw is doubled; the tongue is fleshy, thick, placed far back, the base obscurely bifid, very entire at the tip; it has hardly any upper eye-lid, the lower one is folding; cavities of the ears white; the warts resemble teats, very numerous on the groin; the chin is marked with prominent dots; the colour, when preserved in spirits, is yellowish, and above it is of a pale olive; the fore feet are three-

toed, beneath they are emarginate, the thumb is larger; the second toe of the hind feet is very long.

Section B.—*Body more oblong, smooth; Legs longer. Frogs.*

Species.

TYPHONIA; Hurricane Frog. Of this species, the distinguishing characteristic is, that the lobes of the ears are oval. It inhabits America, and is said to make a noisy croaking before hurricanes and whirlwinds. The back is marked with four longitudinal wrinkles, elevated points, and black spots; the hind toes are narrow, without claws, the second is very long.

PENTADACTYLA; Mackerel Frog. All the legs are fasciate, five-toed; body veined, the dorsal streaks transverse, the lateral ones ocellate. There is a variety which is brown; the fore feet have four toes, with the rudiment of a fifth; the hind feet have five toes, with the rudiment of a fifth.

OCELLATA; Ocellate Frog. The ears are marked with an ocellate spot; feet with claws, the hind ones subpalmate. It inhabits America.

PIPIENS; Clamorous Frog. This is green, with numerous ocellate spots, surrounded with a yellowish ring. This species is smaller than the green frog, but, in its general habits, it bears a considerable resemblance to that animal. It is a native of North America, and frequents rivulets and ditches of water, and is so strong and vigorous, that it is said it can leap to the distance of five or six yards. In the spring and beginning of summer, it is said to indicate the approach of rain by the peculiar sound which it emits. In the living animal the ears are of a shining gold colour; the region of the anus is very much wrinkled; the third fore toe from the thumb longer than the rest; the body resembles that of the esculent, or green frog, but the hind thighs are longer; the shanks are longer still, and hind feet are longer than these, marginate on each side; the toes are connected nearly to the tip, the fourth is longer than the rest.

BICOLOR; Blue and Yellow Frog. Colour blue, ochreous beneath, feet unwebbed; toes flattened and orbicular. This elegant species is of a moderate size; it measures more than four inches in length. The whole of the upper surface is of a beautiful blue, while the under parts are of a pale orange, or ochre colour. The head is large, the mouth wide, and the tip of the nose truncated. All the toes are furnished with a large orbicular tip, and beneath each of the joints there is a process or tubercle. The upper parts of the female have a deeper shade of violet than those of the male. It is supposed to be a native of Surinam.

MAXIMA; the Great Frog. All the feet are palmate, as well as the toes, fasciate; body veined and variegated; the top of the back obliquely spotted. Bands of the legs in pairs, approximate, above confluent.

ALPINA; Alpine Frog. This is entirely black, and inhabits the declivities of the mountains in Austria.

VENULOSA; Veined Frog. Feet cleft; the body veined with confluent spots. It inhabits India and South America.

VIRGINICA; Virginian Frog. Cinereous, spotted with red, beneath it is yellowish; the back is five-angled, with as many stripes. It is found in Virginia.

***TEMPORARIA**; or Common Frog. The back of this is flattish and sub-angular. There is a variety, which is of a dirty olive colour, with large warty spots, the head above plain, beneath whitish; twice the size of the common frog. Both are found in this country, and the latter also in Persia; it lives, during the spring, in water, among toads, and in the summer

summer on land, at which time it is silent; it feeds on various insects, and is the prey of ducks and cranes, croaks very much when in muddy ditches; the variety makes, by night, a noise like that of an angry man.

Of all the European species this is the most common. The general colour is of an olive-brown, variegated on the upper parts of the body with irregular blackish spots. The patch beneath each eye, which reaches to the setting on of the fore-legs, seems to constitute one of the principal specific distinctions. The under part of the body is of a pale greenish colour, and obscurely spotted. But it ought to be observed, that the colour of the frog varies at different seasons of the year, and perhaps in different places. Towards the end of summer, for instance, the colours are much brighter; and as this species frequently calls its skin, the cuticle falling off irregularly from different parts of the body, produces considerable variations in the intensity of the colours.

The frog has a light elegant form and a lively appearance; the limbs are well calculated for its peculiar motions, and the hind feet being strongly webbed, enable it to swim well. The frog, it is said, does not reach its full size till it is five years old, and it lives from twelve to fifteen years. It retires during the heat of summer to the water, and in winter it becomes torpid, and is generally found in the soft mud at the bottom of stagnant waters, or in the cavities beneath their banks, where it remains till the return of spring.

The frog, as well as many other of the reptile tribe, is extremely tenacious of life. It survives, for a considerable time, the loss even of some of its essential organs, and it has been found to exist for several days when entirely confined under water.

The frog deposits its spawn in the month of March. This is composed of a gelatinous transparent mass, including the ova or eggs, in each of which is imbedded the embryo or tadpole, which has then the appearance of a round black globule. The period of hatching varies according to the temperature of the season, but it is commonly in about a month or five weeks. In its progress the egg becomes gradually larger, and before the tadpole is excluded, it is seen in motion within the surrounding gluten. When they are first hatched, their only food is the remains of the gluten in which they were included. A few days afterwards, if they are minutely examined, a pair of ramified branchiæ, or temporary organs, may be observed on each side of the head, which after a short time disappear. The tadpole, which is so extremely unlike the animal in its perfect state, seems to consist only of a head and tail. The head is large, black, and roundish; the tail is slender, and margined with a broad transparent fin. The motions of the tadpole are very lively. Its food consists of duck-weed and other small water-plants, with different kinds of animalcula. The mouth is furnished with very minute teeth, and when the tadpole has reached a certain size, it may sometimes be heard gnawing the edges of the leaves on which it feeds. By means of a sucker placed between the lower jaw, with which the animal in this state is furnished, it can attach itself at pleasure to the under surface of aquatic plants. When it is very young, it sometimes hangs from this part by means of a glutinous thread, similar to some small slugs.

The internal structure of the organs of the tadpole is very different from that of the future animal. In no respect is this difference greater than in the disposition of the intestines, which are coiled in the form of a flat spiral, like a cable. The first change which appears on the tadpole is at the end of five or six weeks after it is hatched. It is about this time that the hind legs first appear; and gradually in-

creasing in length and size, they are succeeded about two weeks afterwards by the fore legs. These latter, indeed, are formed at an earlier period beneath the skin, and are sometimes protruded, and again drawn back by the animal, through a small hole on each side of the breast, before their complete evolution. The tail now gradually decreases, and afterwards more rapidly, so that in the space of a day or two, it is quite obliterated. After this change, the animal leaves the water, and covers the banks in myriads. The sudden appearance of such multitudes of young frogs, has probably induced the groundless but popular belief, of their having fallen from the clouds in showers. The frog having now arrived at its perfect form, it changes entirely the nature of its food. It lived formerly on vegetables, now it depends solely for its existence on animal food. It lives chiefly on small snails, worms, and insects. To seize its prey, the structure and position of the tongue are remarkably well fitted. It is of considerable length, and is attached to the fore part of the mouth; and when at rest it lies backwards. The extremity is bifid, and secretes a glutinous matter, so that in this way it can secure its prey, by darting out its tongue with great celerity, and to some distance from the mouth. This it does with so instantaneous a motion, that it is scarcely perceptible to the eye.

MARGINATA; Bordered Frog. The sides of this are margined, and the feet cleft. It inhabits India and South America.

*** ESCULENTA**; Esculent, or Edible, or Green Frog. Of this species the distinguishing characteristics are, that it is of an olive colour, spotted with black, with three yellowish lines on the back; the abdomen is whitish.

Of all the European frogs this is the largest species. The general appearance is very like that of the *R. temporaria*, but it is larger in size, and of an olive-green colour, strongly marked on the upper part of the body with roundish black spots. The limbs are elegantly marked with transverse bands of the same colour. Three distinct pale yellow stripes run from the tip of the nose down the whole length of the back; the middle one being slightly depressed, but the two lateral ones are considerably elevated. The head is proportionably larger than that of the common frog.

The green frog is rare in England, but is very common in France, Italy, and Germany, where it is employed as an article of food.

This species, it is observed by naturalists, does not leave its winter retirement till a much later period than the common frog; and in those countries where it is used as food, it is worth while to attend to this fact: for if they are pretended to be brought to market at an earlier period, the common frog, and sometimes even toads, must be substituted. During the breeding season, the croaking of the male is so loud, that it may be heard at a great distance; and in those places where they are numerous, it becomes so intolerable to those who are unaccustomed to hear them, that they are often deprived of sleep. At this time, too, a large inflected globular vesicle is protruded from each side of the head of the male. The globules of spawn in the green frog are proportionally smaller than in the former species: they have somewhat of a yellowish cast. The progress of the tadpole, towards the evolution of the perfect animal, is considerably slower in this species. The fore legs do not appear before October, and the animal does not assume its perfect shape till the beginning of November. The tail at this time begins to decrease, and in the space of four days entirely disappears.

This species is extremely voracious, seizing, it is said, on young

young birds of different kinds, mice, and even ducklings, and, as it does with the rest of its prey, swallowing them whole. At the end of four years it has reached its full growth. It begins to breed the year following, and the period of its life is sometimes extended to sixteen years.

AUSTRALISIA; Australian Frog. The body of this is brown above, beneath blueish; the sides are speckled with ochre colour; the toes of the fore feet are spiny. It inhabits New Holland. The second toe of the hind foot is very long; the claws are red.

PARADOXA; Paradoxical Frog. This is of a yellowish and olive colour, variegated with rufous bands; the hind legs or thighs are obliquely streaked.

In its general form this species resembles the *R. temporaria*. The oblique longitudinal stripes on the hind legs constitute the principal mark of distinction. There are four toes on the fore feet, and they are unwebbed; the hind feet have five toes, and are deeply palmated to the very ends of the toes. Near the shortest toe there is an oblong callus, forming a spurious one. The upper jaw is beset with a row of small denticulations. This species is a native of South America, and is more common in Surinam than in other places.

Naturalists, says Dr. Shaw, have been extremely puzzled with regard to the real nature of what has been taken for the tadpole of this frog. At one time it was considered by Linnæus as a species of lizard, and therefore arranged by him under the genus *lacerta*. At another time he has placed it under the present genus, with the specific name *piscis*. It was described by Edwards under the denomination of the frog-fish of Surinam. The structure of the animal, which has been the subject of so much discussion, shews clearly that it is the larva or tadpole of a frog; and it is supposed, with no small degree of probability, that the differences in the accounts given of this animal by naturalists have arisen from the different stages of its progress, in which it has been found. But as this tadpole is so much larger in size, in proportion to the perfect animal, than any other species yet known, it may be the larva or tadpole of some of the larger species, and not that of the *R. paradoxa*, which is but a small frog.

C. *Hind Feet very long; the Claws lenticulate.*

ARBOREA; Tree-Frog. The body of this species is green, beneath granulate; feet cleft. Gmelin enumerates five varieties of this species. 1. Those which have four toes to their fore feet, and five to those that are behind; the knees are warty beneath. 2. Those that are of a green colour, with a straight yellow line on each side. 3. The body of this variety is reddish. 4. Of this it is brownish-green. 5. The slenderness of the body marks this variety.

"In the beauty of its colours," says Dr. Shaw, "as well as in the elegance of its form, and agility of its movements, the tree-frog exceeds every other European species. It is a native of France, Germany, Italy, and many other European regions, but is not found in the British islands. Its principal residence, during the summer months, is on the upper parts of trees, where it wanders among the foliage in quest of insects, which it catches with extreme celerity; stealing softly towards its prey, in the manner of a cat towards a mouse, and, when at the proper distance, seizing it with a sudden spring, frequently of more than a foot in height. It often suspends itself by its feet, or abdomen, to the under parts of the leaves; thus continuing concealed beneath their shade. Its size is smaller than any European frog, except the *R. bombina*. Its colour, on the upper parts, is more or less bright in different individuals; the ab-

domen is whitish, and marked by numerous granules; the under surface of the limbs is reddish; and the body is marked on each side by a longitudinal blackish or violet coloured streak, separating the green of the upper parts from the white colour of the lower: the inferior edge of this dark lateral stripe is tinged with yellow. The body is smooth above, and moderately short or plump; the hind legs are very long and slender; the fore feet have four, and the hind feet five toes, all of which terminate in rounded, flat, and dilated tips, the under surface of which, being soft and glutinous, enables the animal to hang with perfect security from the leaves of trees, &c. The skin of the abdomen is also admirably calculated by nature for this peculiar power of adhesion, being covered with small glandular granules, in such a manner as to fasten closely even to the most polished surface; and the animal can adhere at pleasure to that of glass, in whatever position or inclination it be placed, by merely prelling itself against it.

Though the tree-frog inhabits the woods during the summer months, yet, on the approach of winter, it retires to the waters, and there submerging itself in the soft mud, or concealing itself beneath the banks, remains in a state of torpidity; and again emerges in the spring, at which period it deposits its spawn in the waters, like the rest of this genus. The male at this period inflates its throat in a surprising manner, and exerts a very loud and sharp croak, which may be heard to a vast distance. The spawn is deposited about the end of April, in small clustered masses; the inclosed globules or embryos being of a pale yellowish-brown colour. The tadpoles become perfect frogs, by the total decay of the tail, about the beginning of August; and soon begin to ascend the neighbouring trees, where they continue to reside during the remainder of the warm season; as do likewise the parent animals, after the breeding season is past. During their residence among the trees, they are observed to be particularly noisy on the approach of rain; so that they may be considered, in some measure, as a kind of living barometers; more especially the males, which, if kept in glasses, and supplied with proper food, will afford an infallible preface of the changes of weather.

LEUCOPHYLA; White-spotted Frog. Body smooth, hoary, with oblong milk-white spots; the fore feet are lobate, the hind feet palmate. It inhabits America, and weighs only about forty-six grains. Eyes of a fine golden colour, and between these, on the sides and middle of the back, there are oblong white spots; the haunches are slender.

SCANTIGERA; Scaly Frog. In this a scaly band reaches half-way round the back; the sides and throat have folds; the fore feet are semi-palmate, the hind feet are palmate. This is about two inches long, and is supposed to be an inhabitant of America. The body is varied with grey and brown in thick aggregate specks, and a few spots down the hind part of the back, in a serpentine direction; the band consists of minute, sub-pellucid, rhomboid, imbricate scales; the hind limbs are twice as long as the fore.

BOANS; Croaking Frog. Body smooth, with continuous dots beneath; feet palmate. There are two varieties. 1. The body above is of a blueish lead-colour. 2. The body of this is inclining to orange. It is found in America, and differs only from the tree-frog in having the feet webbed, and the body marked with white spots.

RANA Arborea, the Tree-Frog. See *RANUNCULUS Viridis*, and the preceding article.

RANA Piscatrix. See *LOPIUS Piscatrix*, and *SEA-Devil*.

RANARIDL, in *Geography*, a town of Austria; 11 miles S. of Aigen.

RANASAGUR, a town of Hindoostan, in Bahar; 18 miles W. of Arrah. N. lat. $25^{\circ} 37'$. E. long. $84^{\circ} 31'$.

RANCAGUA, a jurisdiction of South America, in Chili. It derives its name from the inhabitants living in single houses, without the appearance of a village; every family lodging in their lonely cottage, four, six, or more leagues from each other. It is not, however, without a capital, consisting of about 50 houses, and between 50 and 60 families, most of them being Mestizos, though their cast is not perceivable by their complexion. The whole jurisdiction may contain about 1000 families, Spaniards, Mestizos, and Indians. Ulloa's Voyage, vol. ii.

RANCE, ARMAND-JOHN LE BOUTHILLIER DE, in *Biography*, the initiator of the order of La Trappe, was of noble descent, and born at Paris in the year 1626. At a very early period he exhibited an extraordinary genius for classical and polite learning; and at the age of 10 he had read many classical works, in the Greek as well as the Latin languages, and is said at that early period to have understood Homer. When he was only 13 years of age, he prepared for the press a new edition of Anacreon, with notes, that displayed considerable talent and research. This was published in 1639. Four years previously to this, he had received the clerical tonsure, and had been nominated a canon of Notre Dame at Paris. He was promoted by the king to the sinecure priory of Boulogne, near Chambor; and he was subsequently promoted to three different abbies, among which was that of La Trappe, and to other places of honour and trust in the church. He studied divinity at the Sorbonne, and in 1651 he was ordained priest; and in less than three years, the degree of doctor of divinity was conferred upon him by the faculty of the Sorbonne. Having thus completed his studies, he entered into the world, and, like one broken from his shackles, he devoted himself eagerly to its honours, pleasures, and gaieties. He soon became a favourite at court, and was appointed almoner to the duke of Orleans, and one of the deputies of the second order in the assembly of the clergy in 1655. On a sudden, and for a cause that never was well understood, he became disgusted with the world, and resolved to renounce for ever its pleasures, enjoyments, and vanities. No sooner had the abbé de Rance formed the resolution than he withdrew to his estate in the country, to deliberate concerning the mode of life which he should pursue. Having made up his mind to embrace the monastic life, he sold his estate, and bestowed the money which it produced on the Hôtel-de-Dieu at Paris. He also resigned all his benefices and dignities, excepting his priory of Boulogne, and the abbey of La Trappe; the latter of which he retained by a special permission of the king, in order to introduce into it a reformation of the statutes and discipline. He took the habit, and made his profession in the year 1664, and set about establishing the gloomy and austere discipline of monkery in its full perfection. The place itself seemed peculiarly adapted to the horrid system which he established, being the most gloomy, barren, and desolate spot in the whole kingdom of France. Here the days of the monks were constantly spent in prayers, tears, contemplation, silence, the perusal of holy books, the hardships of bodily labour, and the practice of the most rigid austerities. All other designs and occupations, however laudable and excellent in themselves, they were to regard as vain and sinful to persons of their order. The least relaxation, or amusement of the most innocent nature, they were not allowed; and they were prohibited from engaging

at all in literary studies. Strange! that a mind stored with liberal knowledge, and distinguished by good taste, should have been so far perverted by superstition and fanaticism, as to devise or sanction such regulations.

That the world might be acquainted with the discipline of his community, he published "A Treatise on the Sanctity and Duties of the Monastic State." As de Rance advanced in years, the severe discipline to which he strictly conformed, rendered him so infirm, that, finding himself unequal to the duties of his post, he resigned it into the king's hands, but was permitted to appoint his successor. At length, worn out with infirmities and mortifications, and lying on a bed of ashes and straw, he died in 1700, in the 74th year of his age. He was author of a great number of theological and other pieces, among which may be mentioned "Moral Reflections on the Four Evangelists;" "The Constitution and Rules of the Abbey of La Trappe," in 2 vols.; and "A Discourse on Purity of Intention." Moreri.

RANCE, in *Geography*, a river of France, which runs into the sea near St. Malo.

RANCHANO, a small island near the coast of Darien, in the Pacific ocean.

RANCHERIA, a town of South America, in the vice-royalty of Granada, and province of St. Martha; 20 miles N.E. of Hacha. N. lat. 11° . W. long. $72^{\circ} 36'$.—Also, a small island in the Pacific ocean, near the coast of Veragua. N. lat. $7^{\circ} 50'$. W. long. $82^{\circ} 16'$.

RANCHERIAS, a name given, in the province of Panama, to assemblies of Indian huts under the jurisdiction of a village. These rancherías are situated to the southward, in the small chasms or breaches of the mountains.

RANCID, in *Rural Economy*, from the Latin *rancidus*, or *rancio*, to be rank, a term applied to substances, which have contracted a strong offensive smell and taste by keeping, as bacon, butter, and all fat substances are apt to do. It would be a very useful discovery, to find out any easy simple method of preventing this effect from taking place.

RANCON, in *Geography*, a river of France, in the department of the Lower Seine, which runs into the Seine, at Caudebec.—Also, a town of France, in the department of the Upper Vienne; 8 miles E. of Bellac.

RANCONET, AIMAR DE, in *Biography*, a learned and worthy magistrate, who flourished in the 16th century, was born at Bordeaux, in which city his father was an advocate of parliament. Having received the advantages of a good education, he became deeply skilled in the Roman law, to the study of which he joined that of philosophy, mathematics, and antiquities. Having been some time a counsellor in the parliament of Bordeaux, he was raised to the post of president of the fourth chamber of inquests in that of Paris. The religious contentions of the time were fatal to him. When the cardinal of Louvain assembled the parliament of Paris, to procure its opinion concerning the punishment of heretics, Ranconet brought the works of Sulpicius Severus, and read aloud the passage in which that writer censures the execution of Priscilian; upon this the prelate caused him to be imprisoned in the Bastille, where he died of grief in 1559, at the age of 60. His latter days had been singularly unfortunate. He was reduced by want to be a corrector of the press to the Stephenes; he saw his daughter die on a dunghill, and his son executed, and his wife was killed by lightning. This learned man published scarcely any thing in his own name, but contributed much to the labours of others. He is said to have had the chief part in the valuable treatise, "De Verborum Significatione," and in the "Formula" of Briçon; and Pithou asserts,

afferts, that he compiled the Dictionary that bears the name of Charles Stephens. He wrote "Le Tresor de la Langue Françoise, tant ancienne que moderne." Moreri.

RANCONNIERES, in *Geography*, a town of France, in the department of the Upper Marne; 9 miles W. of Bourbonne.

RANDAL, Dr. JOHN, in *Biography*, organist, doctor in music, and music professor in the university of Cambridge. He was brought up in the king's chapel, was one of the children of that choir who first performed in Handel's oratorio of Esther, at the house of Bernard Gates, master of the boys in James-street, Westminster, on Wednesday, February 23, 1731, when it was performed in action, previous to its having been heard in public, or any where but at Cannons, the magnificent seat of the duke of Chandos, for whose chapel it was composed in 1720.

Randal was never rated very high in his profession: he was regarded as a slight organ-player, and had never distinguished himself as a composer. He obtained his degree at the installation of the duke of Grafton in the university of Cambridge, for which he composed the ode written by Mr. Gray, to the astonishment of all the musical profession, by undertaking to have it performed by the musicians resident in the university, without putting his grace to the expence of additional hands and voices from London, as Drs. Greens and Boyce had thought necessary on former occasions at Cambridge, and Dr. William Hayes at Oxford.

As Dr. Randal's professional life was unmarked by talents, his death, which happened in 1799, was hardly noticed, except by the candidates for the professorship, and his organist's places.

RANDALSTOWN, in *Geography*, a post-town of Ireland, in the county of Antrim, in the neighbourhood of which is Shanes castle, the seat of lord O'Neill. It is situated on the river Maine, to the northward of lough Neagh. Randalstown is 4 miles N.W. from Antrim, and 88 N. by W. from Dublin. Before the union, it was represented in parliament. Carlisle, &c.

RANDANS, a town of France, in the department of the Puy-de-Dôme, and chief place of a canton, in the district of Riom; 12 miles N.E. of Riom. The place contains 1047, and the canton 7996 inhabitants, on a territory of 130 kilometres, in 11 communes.

RANDASALMI, a town of Sweden, in the government of Kuopio; 52 miles S. of Kuopio.

RANDAZZO, a town of Sicily, in the valley of Demona; 25 miles W. of Taormina. N. lat. 37° 57'. E. long. 15° 4'.

RANDEER, a town of Hindoostan, in Guzerat, on the Taptee, opposite to Surat.

RANDEGG, a town of Austria; 8 miles N.N.E. of Bavarian Waidhoven.

RANDERADT, a town of France, in the department of the Roer; 10 miles N.W. of Juliers. N. lat. 50° 59'. E. long. 6° 8'.

RANDERS, a town of Denmark, in North Jutland, on the Gulden. This town is reduced, and has now only one parish church, a grammar-school, an hospital, and a chapel near the town. The chief articles of trade consist of leather gloves, salmon, earthen-ware, and strong beer. It was formerly well fortified; 20 miles E. of Viborg. N. lat. 56° 28'. E. long. 10° 3'.

RANDERSACKER, a town of the duchy of Wurzburg, on the Maine; 2 miles S. of Wurzburg.

RANDIA, in *Botany*, was so named by Houstoun and Linnaeus, in honour of Mr. Isaac Rand, F.R.S., an apothecary in London, who filled the place of lecturer and de-

monstrator of botany in the Chelsea garden, from the year 1722 to 1739. He published in 1730 an octavo index of the official plants of that collection, 518 in number, specifying the part of each used in physic. He also printed, in 1739, a general catalogue of the Garden. His name often occurs among the botanists of that period. The *Randia*, however, of which two supposed species are defined in Linn. Sp. Pl. 213, 214, by the names of *mitis* and *aculeata*, both West Indian shrubs, is now sunk in *GARDENIA*; see that article, where we have suggested a doubt, possibly not well founded, of the propriety of this incasure. Both species of *Randia* are united by Willdenow, Sp. Pl. v. 1. 1230, on the authority of Swartz, as well as in Ait. Hort. Kew. v. 1. 370, under the name of *Gardenia Randia*. This plant, sent by Houstoun to Miller, before the year 1733, does not appear to exist in our stores at present. Its form may be seen in Browne's Jamaica, 143, t. 8. f. 1. That author says the pulp of the berries stains paper or linen of a fine permanent blue, which resists the action of soap and of acids. The shrub is frequent in the low lands of Jamaica, on the most barren clay soil.

RANDNITZ, in *Geography*, a town of Bohemia, in the circle of Schlan; 12 miles N.N.E. of Schlan. N. lat. 50° 23'. E. long. 14° 24'.

RANDOLPH, THOMAS, in *Biography*, an English poet of great celebrity, was born at Newnham, in Northamptonshire, in 1605. He was educated at Westminster school, and having completed his course, he was elected to Trinity college, Cambridge. He shewed an early turn for poetry, and at ten years old wrote "The History of the Incarnation of our Saviour," in verse. He acquired an unfortunate, and, to him, a fatal habit of conviviality, which diverted him from the pursuit of any profession, and which led him to waste his scanty patrimony, and his health, in the company of wits and men of pleasure in the metropolis. He died in his 30th year, to the great regret of those who admired his poetry and loved his company. He possessed an excellent genius, and had his life been extended, it has been thought he might have attained to a very high rank among the poets of his age. His miscellaneous poems were collected after his death by his brother, who published them at Oxford, in 1640. They have been, but not of late years, several times reprinted. He likewise composed six dramatic pieces of the comic class, one of which, "Hey for Honesty, down with Knavery," was taken from the *Plutus* of Aristophanes. His pieces are said to be some of the best in the manner then prevalent, which consisted in playing with words and thoughts, and connecting remote ideas by fanciful resemblances. His expressions are often elegant, and his verses harmonious. His friend, sir Christopher Hatton, caused, at his own expence, a monument of white marble to be erected over his grave, the inscription on which, in Latin and English verse, was made by Peter Hausted. Biog. Brit.

RANDOLPH, JOHN, a learned prelate of the church of England, descended from a respectable family in Kent, was born July 6th, 1749. He was the younger son of Dr. Randolph, formerly president of Corpus Christi college, Oxford, who died in March 1783, after having presided over the college for the long space of 35 years. The president's father was recorder of Canterbury, and had several sons, among whom was Dr. Francis Randolph, principal of Alban Hall, Oxford. The whole family have been remarkable for their orthodox zeal and attachment to the established religion of the country. The subject of this article became a student of Corpus Christi college, Oxford, where he took his several degrees, that of D.D. he had by diploma in 1783. Pre-

viously to this he had been appointed prelector of poetry, proctor, and in 1782 Regius professor of Greek. In this same year he was made prebendary of Salisbury, canon of Christ-church, and Regius professor of divinity; and in 1783 rector of Ewelme. In 1799 he was elevated to the bishopric of Oxford, from which he was translated to that of Bangor in 1807, and then to the metropolitan see of London in the year 1809. Notwithstanding these high preferments he passed a great part of his life in the university of Oxford, and it was generally believed that when he was elevated to the see of Oxford, the university was complimented with the nomination by the crown. His lordship was author of many single sermons, and charges delivered on different occasions: also of "De Græcæ Linguae Studio Prælectio habita in Scholâ Linguarum," 1783, and "Concio ad Clerum in Synodo Provinciali Cantuariensis Provinciæ ad D. Pauli," 1790. His lordship was a zealous promoter of the *National schools* in opposition to those founded by Lancaster, and he was understood to be a violent opponent to the bible society, and to the spread of what has been termed Sectarism. One of his last works was a Report of the Progress made by the National Society, to which the general committee referred in terms of gratitude, at their first meeting after his lordship's decease, in the following terms; "whose latest employment had been to state, for the information of the public, the progress of a work to which he had contributed his time, his labour, and his counsels, the committee could not fail to entertain a common sentiment of profound regret for the loss which they have sustained, and to cherish in their minds the liveliest recollection of the service which has been so successfully fulfilled by him in this second report. They wish, therefore, to add to this document, designed for general circulation, their sense of what is due from the public, and themselves, to the memory of one who was a constant and assiduous promoter of this salutary institution, from its first establishment to the last hour of his life.—The committee trust, that this testimony, though limited to a single object in the large field of pastoral duty in which he was incessantly engaged, may serve to denote the benefits which have resulted from his prompt, unwearied, and effectual exertions." The following is the character drawn of him by Mr. arch-deacon Jefferson, and which alludes to his zeal for the church of which he was an active member. "Fearless now of being censured for mercenary adulation, or reproved by unconscious merit, a just tribute may be paid to the character of that departed and exalted prelate, who is, and will be, most lamented where he was best and most entirely known. This opportunity, therefore, is willingly embraced of offering a heart-felt condolence to the ministry of the diocese on the affecting and important loss, which, in these perilous times of contending sects and unsettled opinion, has arisen to them, and to the church:—To them, in the premature privation of a diocesan, firm in his support of ecclesiastical authority, but considerate in its application; eminently versed in the letter of ecclesiastical law, but liberal in its practical construction, reluctant in interference, but determined in duty, slow in the profession of service, but prompt in its execution; disinterested in patronage, unwavering in measures, correct in judgment, attentive in counsel, and kind and compassionate to distress:—To the church, in the premature privation of a father, diligent in her rites and services, but unostentatious in piety and devotion; found and unrelaxing in her doctrines and faith, but discreet in zeal, and comprehensive in charity; ever vigilant in defending her interests, ever forward in asserting her privileges, and ever able in the assertion and the defence." The bishop died suddenly on the 28th of July 1813. He was one of the governors of the

Charter-house; trustee of the British Museum; dean of the Chapel royal; visitor of Sion college; and provincial dean of Canterbury. Gent. Mag.

RANDOLPH, in *Geography*, a post-town of America, in Massachusetts, formed of the S. precinct of Braintree, in Norfolk county, in the year 1783; 15 miles S.E. of Bolton. The inhabitants are mostly farmers, but manufacture large quantities of shoes for market.

RANDOLPH, a county of Hillsborough district, in North Carolina, bounded N.E. by Orange, and N.W. by Guilford. The number of inhabitants is 10,112, and they are mostly Quakers; the other denominations are Presbyterians, Baptists, Methodists, and Universalists. Their good land produces 40 or 50 bushels of Indian corn, or 20 of wheat, *per acre*. The chief town is Ashborough.

RANDOLPH, a county of Virginia, bounded N. by Monongalia, and S. by Pendleton. The number of inhabitants is 2854.

RANDOLPH, a post-town in Orange county, Vermont, being the 4th town W. of Thetford, on Connecticut river. The number of inhabitants is 2255. White river, by its two branches, waters the E. and W. side of the town. It has a large bed of iron ore, two forges, and a slitting mill. The congregational meeting-house has a steeple, and is large; 47 miles from Rutland.

RANDOLPH, a county of the Indiana territory.

RANDOLPH, a town of Morris county, in New Jersey, containing 1271 inhabitants.

RANDOM, a township of Essex county, in Vermont, W. of Brunswick.

RANDOM *Island*, a small island in Trinity bay, near the E. coast of Newfoundland. N. lat. 48° 15'. W. long. 53° 40'.

RANDOM *Shot*, a shot made when the muzzle of a gun is raised above the horizontal line, and is not designed to shoot directly, or point-blank.

The utmost random of any piece is about ten times as far as the bullet will go point-blank; and the bullet will go farthest when the piece is mounted to about forty-five degrees above the level range.

The space or distance of the random is reckoned from the platform to the place where the ball first grazes.

RANDOW, in *Geography*, a river of Brandenburg, which runs into the Ucker; three miles S. of Uckermonde.

RANDS, a lake of Norway, in the province of Aggerhuus, 35 miles long, and two broad; 20 miles N. of Christiania.

RANDSBERG, a town of Sweden, in West Gothland; 76 miles E. of Uddevalla.

RANDYCHOAR, a town of Bootan; 18 miles N. of Beyhar.

RANEA, a town of West Bothnia; 60 miles W. of Toræa.

RANELAGH, *Rotunda and Gardens*, built and opened for musical performances and public amusements in 1742. The building was erected in the spacious garden belonging to the residence, at Chelsea, of lord Ranelagh, one of the ministers of Charles II., when paymaster of the army.

It was planned by the late Mr. Lacey, afterwards joint-patentee of Drury-lane theatre with the great actor Garrick.

At the first opening of this stupendous building, several experiments were made in placing the orchestra, in filling it, and in the time of performance, before it was settled as an evening promenade. The orchestra was at first placed in the middle of the rotunda. The performance was in a morning; and oratorio chorusses chiefly furnished the bill of fare. Sir John Barnard complaining to the magistrates, that

that the young merchants and city apprentices were frequently seduced from their counting-houses and shops by these morning amusements, they were prohibited, and the doors opened at six o'clock in the evening. The performance, however, did not begin till eight o'clock, but was ended at ten.

It was intended to rival Vauxhall, and was little injured by bad weather; as the company, at such times, had a safe and pleasant retreat into the rotunda, and as few went thither but in carriages.

Its success as an evening's amusement remained undiminished more than 40 years. It was ruined by the late hours to which it was gradually brought by fine folks, who, at length, never came thither till past ten o'clock, when the musical performances were over, and sober people used to return home before eleven o'clock to their supper, which enabled them and their servants to go to bed, and rise, at their accustomed time.

But, at length, persons of rank and fashion made a debauch of this innocent amusement, and went to it and departed from it as late as at a masquerade. This precluded all that had any thing to do themselves, or any employment for their servants in the morning, and so much refined the company, that at midnight there had been seldom sufficient money received at the entrance, to cover the expences of the lamps, the terms of admission being only 3s., for which, besides a good concert by the best performers in London, the company was furnished with excellent rolls, butter, and tea. In the year 1803 it was shut up, and only used occasionally for a masquerade, a festival, or an exhibition of fire-works. But since the period just-mentioned, the building has been pulled down, and the materials sold piecemeal, as was the case at Cannons, the splendid mansion of the duke of Chandos, (or *Palazzo*, as it would have been called in Italy,) and the ground is now (1809) of no other utility than occasionally to drill and exercise the Chelsea volunteers.

RANES, in *Geography*, a town of France, in the department of the Orne; 10 miles S.W. of Argentan.

RANESTAD, a town of Sweden, in Angermannland; 50 miles N.N.E. of Hernösand.

RANFORCE RING. See REINFORCED *Ring*.

RANG, in *Geography*, a town of Sweden, in the province of Skonen; 11 miles S.S.W. of Lund.

RANGA, in *Hindoo Mythology*, one of the many names of Siva, the personification, according to the Hindoo mythologists, of the destructive or changing form of the deity. (See *SIVA*.) The epithet Sri, meaning holy, or divine, or blessed, prefixed, has given this name to the capital of Myfore; Sri Ranga-pattan being the city of the blessed Ranga, altered by Europeans to Seringapatam. See *SRI*.

RANGALORE, in *Geography*, a town and fortress of Hindoostan, in the circar of Cicacole; 38 miles W. of Cicacole.

RANGAMATTY, a circar of Bengal, bounded on the N. by Bootan and Assam, on the E. and S. by Assam, and on the W. by Baharbund, Bettrebund, and Goolah; about 40 miles long, and from 10 to 40 broad. Rangamatty, the capital, is 128 miles N.N.E. of Moorhedabad, and has a celebrated pagoda. N. lat. 26° 8'. E. long. 90° 6'.

RANGANJA, a town of Bengal; 15 miles N.E. of Chittigong.

RANGAPALEAM, a town of Hindoostan, in Coimbatore; eight miles N.N.E. of Daraporum.

RANGAPILLA, a town of Hindoostan, in the Carnatic; six miles N.E. of Pondicherry.

RANGASUNDRUM, a town of Hindoostan; 15 miles W. of Tinevelly.

RANGE, in *Gunnery*, the path of the ball, or the line it describes from the mouth of the piece to the point where it lodges. The flight of a shot is distinguished, by artillerymen, into three different ranges, of which the first is called the *point-blank*, the second the *random-shot*, and the third the *ricochet*, or rolling and bounding shot. The first, or point-blank, is to suppose a piece stood upon a level plain, and laid level, then the distance between the piece and the point where the shot touches the ground first, is called the *point-blank range* of that piece; but as the same piece ranges more or less, according to a greater or less charge, the point-blank range is to be understood to be that, when the piece is loaded with that charge which is commonly used in action.

This range is much less than the greatest range, or random-shot; but the piece cannot be levelled, or, as it is generally expressed, *pointed* at an object intended to be battered, if that object is not within the distance of the point-blank range; for beyond that the shot is very uncertain, therefore rarely used in the sea-service, and on land only when the shot cannot fail of doing great execution in the place on which it falls.

In ricochet firing, the piece is only elevated from three to six degrees, and loaded with a small charge, in order that the ball may be bounded, and roll along the inside of the parapet. The shot, thus discharged, goes rolling and bounding, killing and maiming, or destroying all it meets in its course, and creates much more disorder by going thus slowly, than if thrown from the piece with greater violence. See *CANNON*, *GUN*, and *PROJECTILE*.

RANGE of a *Projectile*, *Amplitude of the*. See *AMPLITUDE*.

RANGE, *Point-blank*. See *POINT-blank*.

RANGE, in a *Ship*, denotes a sufficient length of the cable, drawn up on the deck, before the anchor is cast loose from the bow, to let it sink to the bottom, without being interrupted, that the flukes may be forced the deeper into the ground, by the additional weight which the anchor acquires in sinking. For this reason, the range, which is drawn up out of the tire, ought to be equal in length to the depth of the water, where the ship anchors.

RANGER, a sworn officer of the forest, whose business it is to walk daily through his charge, to drive back the deer out of the purlieus or disafforested places into the forest lands; and to prevent all trespasses done in his bailiwick at the next court held for the forest.

The ranger is made by the king's letters, and has a fee paid yearly out of the exchequer, and certain fee-deer. In the *Charta de Foresta* mention is made of twelve kinds of rangers. It is now principally a honorary and sinecure employment; but the holders sometimes likewise receive pay.

RANGES, in *Ship Building*, horned pieces of oak, like belaying cleats, but much larger, bolted to the inside of a ship, in the waist, for belaying the tacks and sheets. Also those pieces of plank fixed between the ports, with semi-circular holes in them for keeping shot in.

RANGIFER, in *Zoology*, a variety of the *CERVUS Taurus*; which see.

RANGING, in *War*, the disposing of troops in a condition proper for engagement, or for marching.

In *Building*, the side of a work that runs straight, without breaking into angles, is said to *range*, or *run range*.

RANGING out a canal, denotes determining or setting out on the ground the lines which are to be occupied by its middle and sides.

RANGLE, in *Falconry*, is when gravel is given a hawk to bring her to her stomach.

RANGOON, in *Geography*, a sea-port town of the Birman

RANGOON.

Birman empire, situated on a branch of the Irrawaddy, called the Rangoon river, which forms the only communication that the Pegue river has with the sea. The town, in its present state, has been extended by increasing trade and consequent population far beyond the limits which formerly comprehended Rangoon, as it was originally founded, in 1755, by Alompra, the sovereign of the Birman empire. Rangoon, or Dzangoon, which signifies victory achieved, was denominated Dagon, before Alompra took it, and laid the foundation of the present town. Here stood, in former days, a large and populous city, called in the Pali, or sacred language, Singounterra; the site of which Alompra diligently explored, and raised on its ruins the present flourishing sea-port of the Pegue dominions. Dagon, often called Shoe-Dagon, or the golden Dagon, is a name peculiar to the temple; a noble edifice, three miles distant from the banks of the river. (See DAGOUNG.) Rangoon stretches along the bank of the river about a mile, and is not more than a third of a mile in breadth. The city, or miou, (mious being a term applied either to a city or a district,) is a square surrounded by a high stockade, in the manner of the country, and on the N. side it is further strengthened by an indifferent fosse, across which a wooden bridge is thrown; in this face there are two gates, in each of the others only one. Wooden stages are erected in several places within the stockade, for musqueteers to stand upon in case of an attack. On the S. side, towards the river, which is about 20 or 30 yards from the palisade, there are several huts, and three wharfs, with cranes for landing goods. A battery, of twelve cannon, six and nine-pounders, raised on the bank, commands the river; but the guns and carriages are in such a wretched condition, that they could do little execution. Close to the principal wharf are two commodious wooden houses, used by the merchants as an exchange, where they usually meet in the cool of the morning and evening, to converse, and transact business. The streets of the town are narrow, and much inferior to those of Pegue, but clean and well paved; there are numerous channels to carry off the rain, over which strong planks are laid, to prevent an interruption of intercourse. The improvement of the town has been very much owing to the activity of the descendant of a Portuguese family, named Jaunsee, of low origin, but advanced at length to the important office of Shawbunder, or intendant of the port, and receiver of the port-customs. Under his direction and influence, the streets were paved, several well built wooden bridges were constructed, and also a wharf, which, extending into the river, and raised on posts, enables the ships to deliver and receive cargoes without the assistance of river-craft; under his direction also a spacious custom-house has been erected. This is the only lay building in Rangoon that is not constructed of wood, it is composed of brick and mortar, and the roof covered with tiles; within, there is a number of wooden stages for the reception of bale goods. The houses, in general, are raised on posts from the ground; the smaller supported by bamboos, the larger by strong timbers. All the officers of government, the most opulent merchants, and persons of consideration, live within the fort; shipwrights, and people of inferior rank, inhabit the suburbs; and one entire street, called Tackally, is exclusively assigned to common prostitutes, who are not permitted to dwell within the precincts of the fortification. Swine are suffered to roam about the town at large; they do not belong to any particular owners, but are regarded as servants of the public, or common scavengers; as they go under the houses and destroy the filth. The Birmans are also fond of dogs, numbers of which infest the streets; the

breed is small, and very noisy. The borders of the terrace on which the temple of Dagounng is raised, are planted with shady trees in regular rows; and from this eminence there is a beautiful and extensive prospect; the Pegue and Rangoon rivers are seen winding through a level woody country, and the temple of Syriam, little inferior to others at Pegue and Rangoon, stands near the junction of the streams. The road leading from the city to the temple is formed with care, a wide causeway in the centre throwing off the rain to the sides; and numberless little spaces are ranged along the edge of the road, in which are niches to receive small images of their divinity Guadma. Several kioums or monasteries lie in this direction, generally removed at a short distance from the public way, under the shade of pipal or tamarind trees. The Birmans being, like other inhabitants of the east, fond of processions, scarcely a week passes in which there is not a religious display at Rangoon; either a funeral of some person who leaves sufficient to defray the expence of a pompous public burning, or the ceremony of admitting youths into the convents of the Rhahaans, on which occasion parents and friends spare no expence in entertainments and presents to the Rhahaans. See RHAAHANS.

The population of Rangoon is considerable; there are 5000 registered taxable houses in the city and suburbs; so that if each house be supposed to contain six people, the estimate will amount to 30,000. Having long been the asylum of insolvent debtors from the different settlements of India, it is crowded with foreigners of desperate fortunes, who find from the Birmans a friendly reception, and generally support themselves by carrying on a small trade. The exchange, if it may be so called, exhibits a motley assemblage of merchants, such as few towns of much greater magnitude can produce; Malabars, Moguls, Persians, Parsees, Armenians, Portuguese, French, and English. The members of this discordant multitude, engaged in various branches of commerce, are not only permitted to reside under the protection of government, but likewise enjoy the most liberal toleration in matters of religion. They celebrate their several rites and festivals, totally disregarded by the Birmans, who have no inclination to make proselytes. In the same street may be heard the solemn voice of the Muezzim, calling pious Islamites to early prayers, and the bell of the Portuguese chapel tinkling a summons to Romish Christians. Processions meet and pass each other without giving or receiving cause of offence. The Birmans never trouble themselves about the religious opinions of any sect, nor disturb their ritual ceremonies, provided they do not break the peace, or meddle with their own divinity Gaudma; but if any person commit an outrage, which the Mussulmen, in their zeal for the true faith will sometimes do, the offender is sure to be put into the stocks; and if that does not calm his turbulent enthusiasm, he is bastinadoed into tranquillity.

The Parsees, the Armenians, and a small proportion of Mussulmen, engross the largest share of the trade of Rangoon; and individuals from their number were frequently selected by government to occupy employments of trust, that related to trade and transactions with foreigners, the duties of which the Birmans conceive that such persons could perform better than themselves. These people, particularly the Armenians, naturally behold with a jealous eye any ordinance of a commercial nature, that may tend to diminish their influence, and deprive them of that dictatorial power, which they assume and exercise over all merchants and mariners that resort to Rangoon; but of none are they so apprehensive as of the English; a connection with whom might teach the Birmans to transact foreign business without their assistance, and give them a more adequate sense of their own interest.

The

The French have long maintained an agent at Rangoon, and are thoroughly acquainted with the advantages which the country of Pegue affords. The imports into Rangoon from the British settlements in the years 1794—5, amounted, according to Mr. Symes, to more than twelve lacks of rupees, about 135,000*l.* sterling: these consisted chiefly of coarse piece goods, glass, hardware, and broad cloth, the demand for the last article being considerable; and returns were almost wholly made in timber. Teak, the most durable wood that is known, and best adapted for the construction of ships, is produced in the Birman and Pegue empire in inexhaustible abundance. The river of Rangoon is equally commodious for the construction of ships; the spring tides rise 20 feet in perpendicular height; the banks are soft, and so flat, that little labour is necessary for the formation of docks: vessels of any burden may be built. Nature, says Symes, has liberally done her part to render Rangoon the most flourishing sea-port of the eastern world. The entrance of the river, about twelve miles below Rangoon, and the banks on each side, bear a near resemblance to those of the Ganges; but the navigation is much more commodious. The channel is bold and deep, from six and a half to eight fathoms, uninterrupted by shoals or inequality of soundings. At this place the breadth of the river is estimated to be from three quarters to one mile. On the bank of the river, opposite to Rangoon, is a considerable town, called Maindu, the residence of the governor of the province of Dalla. This government is entirely distinct from Rangoon, on the east side. The city of Dalla, from which the province takes its name, is said to be on the west side of the China Buckier river, and was formerly a place of considerable importance. The town of Maindu is composed of one long street; at the east end is a creek, which goes all the way to Bassein, and has twelve feet depth of water, at high tide; on the west side is a smaller creek, on the bank of which stands a village called Mima-Shunrua, or the village of prostitutes, being wholly inhabited by women of that description. Rangoon lies in N. lat. 16° 47'. E. long. 96° 9'. Symes's Embassy to Ava, in 3 vols. 8vo. See BIRMAN Empire.

RANGSIO, a town of Sweden, in Helplingland; 15 miles W.N.W. of Soderhamn.

RANGUANA, a small island in the bay of Honduras, near the coast of Mexico. N. lat. 16° 25'. W. long. 88° 52'.

RANHADOS, a town of Portugal, in the province of Beira; 18 miles N.W. of Castel Rodrigo.

RANINA, *Arteria et Vena*, in *Anatomy*. the artery and vein situated on the inferior surface of the tongue. See ARTERY and VEIN.

RANINAL VESSELS, *Bleeding from*. See FRÆNUM LINGUÆ, *Division of*.

RANISH, in *Geography*, a small island near the W. coast of Scotland. N. lat. 57° 55'. W. long. 5° 5'.

RANK, a due order, or a place allotted a thing suitably to its nature, quality, or merit.

Kings are persons of the first rank on earth. In cavalades, processions, &c. every person is to observe his rank.

RANK, in *Military Discipline*, denotes a series, or row of soldiers, placed side by side; a number of which ranks form the depth of the squadron or battalion, as a number of files does the width.

When infantry is drawn up three deep, the first rank is called the *front* rank; the second, the *centre* rank; and the third, the *rear* rank.

To *close the rank*, is to bring the men nearer; to *open* it, is to set them farther apart. To *double the ranks*, is to throw

two into the space of one, by which the files are thinned. See DOUBLING.

RANK, in the *Army and Navy*, is used for the order of *precedence*; which see.

In the army the officers in the life-guards are entitled to the rank of lieutenant-colonel, when they obtain or purchase a majority, provided they are of seven years standing. Their commissions in this case run major and lieutenant-colonel. But if an officer should not have completed either of those periods, he obtains the rank of major only until its completion. A lieutenant-colonel attains to the rank of full colonel if he has been seven years major, or twenty-one years in the British service. Cornets in the life-guards rank as sub-lieutenants in their own corps, and as first lieutenants in the army. The English fuzileers enjoy the same privilege. Sub-lieutenants in the Welsh fuzileers, rank only as second lieutenants in the army. Marines do the same.

Officers of the regular forces command the officers of equal degree belonging to the other services. Officers of the militia, fencibles, yeomanry cavalry, and volunteer corps, rank together, according to the dates of their respective commissions. These regulations are subject to some exceptions, specified in the articles of war. Officers of the militia rank generally with the regular forces as junior of their respective commissions. An ensign in the guards ranks no higher than an ensign in the regulars. The chief of the engineers ranks as colonel; director, as lieutenant-colonel; sub-director, as major; engineer in ordinary, as captain; engineer extraordinary, as captain-lieutenant; sub-engineer, as lieutenant; practitioner-engineer, as ensign.

In the navy the admiral or commander-in-chief of his majesty's fleet has the rank of a field-marshal; admirals, with the flags on the top-mast-head, rank with generals of horse and foot; vice-admirals, with lieutenant-generals; rear-admirals, as major-generals; commodores with broad pendants, as brigadier-generals; captains of post-ships, after three years from the date of their first commission, as colonels; other captains, commanding post-ships, as lieutenant-colonels; captains, not taking post, as majors; and lieutenants, as captains.

RANK, *Brevet*, rank without pay, nominal distinction, which sometimes entitles the holder of it to command in mixed service. The brevet rank in the militia is confined to the colonels and adjutants of the several corps in that establishment. The former receive the brevet rank of colonels in the army whilst actually embodied for service, and command all lieutenant-colonels in the line when they do duty together. Adjutants in the militia may have the brevet rank of captain, provided they have served five years as lieutenants in the militia, or in other forces on the British establishment. In the line, an adjutant who has the rank of captain, may command as such when there is no superior officer on the parade, or for duty. This is not the case in the militia. No adjutant, let his brevet rank of captain be ever so ancient, can command the youngest captain of a company. The same difference prevails with respect to the captain-lieutenancy; which is literally brevet rank. In the regulars, a captain-lieutenant, the instant he is promoted to a company, takes rank according to the date of his first commission, and, as we have observed, may be major by brevet; but no captain-lieutenant can ever avail himself of that seniority to the prejudice of a captain of a company in the militia; nor can an officer in the latter establishment take advantage of his standing, when he quits one regiment to serve in another, even in time of war, although he may have the requisite qualifications in both counties.

Brigade majors rank with captains, provided they have that

that rank in the army, independent of their staff appointment. But aids-de-camp do not possess any rank in that capacity with regard to the army. The latter constitute a part of the general's family, and are paid out of his allowance; they are in fact the mere carriers of his orders in the field, and his domestic inmates at home, &c. The former belong to the brigade, and are a necessary part of its effective force. It has been judiciously ordained, that both the one and the other should be regular officers.

There is likewise a sort of brevet rank which exists in the several regiments belonging to the British service, and is confined to the rank and file, or corporals and private soldiers. Thus a lance-serjeant is a corporal who does the duty of serjeant without the pay or emoluments of the latter; and a lance-corporal is a private soldier who does the duty of corporal. So that *lance*, which comes from *lansquenet*, and ought therefore to be written *lans-serjeant*, &c. is the abbreviation of that word, which signifies a private soldier, and is derived from the German, and when put before serjeant or corporal, points out, that a private soldier has the brevet rank of one of those situations. Captains of companies appoint or reduce lance-serjeants or corporals, according to their judgment.

RANK, in respect of ships. See RATE.

RANK and File, denote men carrying the fire-lock and standing in the ranks. Thus corporals are included in the return which is made under that head.

RANKS and Files, are the horizontal and vertical lines of soldiers, when drawn up for service.

RANK Keel, in Ships. See KEEL.

RANK Modus, in Law. See MODUS.

RANK is also a term provincially applied to signify any sort of crop of large growth, standing thick or close on the ground, as corn, pease, beans, &c. and even trees in woods. The term is often used to denote corn or grass crops, which are of such strong growths as to be laid down or lodged.

RANKAH, in Geography, a town of Bengal; 25 miles W.N.W. of Palamow.

RANKERAH, a town of Hindoostan, in Candeish; 25 miles S. of Burhanpour.

RANKNESS in Cheese, in Rural Economy, a term signifying its strong pungent quality arising from the impurity of the rennet or steep, either in consequence of neglect of the vessels holding it, the want of salt, or the imperfect separation of the curdy matter from the whey, by which fermentation and partial putrefaction occur and produce this taste. See CHEESE and DAIRYING.

RANKPORE, in Geography, a town of Hindoostan, in Guzerat; 45 miles E. of Radunpour.

RANNEE, a town of Hindoostan, in Orissa; 30 miles S.S.W. of Balasore.

RANNEL-BAUK, in Rural Economy, a word provincially used to signify the wooden bar or bauk laid across the cottage chimney, for hanging the pot-hooks on, &c.

RANNIGUNGE, in Geography, a town of Bengal; 76 miles N.N.E. of Dacca.

RANNING, a town of the duchy of Wurzburg; five miles N. of Schweinfurt.

RANNISERAI, a town of Hindoostan, in Allahabad; 35 miles N.W. of Gazypour.

RANNUTSCH, a town of Thibet; 36 miles E. of Jemlah. N. lat. $30^{\circ}42'$. E. long. $82^{\circ}15'$.

RANNY, in Rural Economy, a provincial word, applied to the small field-mouse.

RANNY Bednore, in Geography, a town of Hindoostan,

in the circar of Sanore; 20 miles W. of Bijnagar. N. lat. $15^{\circ}18'$. E. long. $75^{\circ}37'$.

RANNYCOTTA, a town of Thibet; 35 miles S. of Gangotri.

RANNYDEE, a town of Bengal; 11 miles S. of Curuckdeagh.

RANNYGONG, a town of Hindoostan, in Dowlatabad; 15 miles S.S.W. of Amednagar.

RANNYGUNGE, a town of Bengal; 35 miles N. of Dinagepour.

RANNYPOOKRA, a town of Bengal; 30 miles W.N.W. of Rogonatpour.

RANO, a small island in the N. part of the gulf of Bothnia. N. lat. $65^{\circ}43'$. E. long. $22^{\circ}52'$.

RANRAN, a town of Cochinchina, and the capital of a province. N. lat. $12^{\circ}30'$. E. long. $108^{\circ}56'$.

RANSACKEN, a town of the duchy of Wurzburg; 3 miles S. of Wurzburg.

RANSOM, a sum of money paid for the redemption of a person out of slavery, or for the liberty of a prisoner of war.

With regard to prisoners of war, it is allowed that there is no obligation of releasing those who are detained as such, till after satisfaction has been obtained. Whoever makes a just war has a right, if he thinks proper, to detain his prisoners till the end of the war; and then, in releasing them, he may justly require a ransom, either as a compensation at a peace, or, if the war continue, for diminishing his enemy's prisoners, at the same time that he strengthens him with the return of soldiers. Prisoners of war, among European nations, are exchanged or ransomed during the war; and this is generally stipulated in a previous cartel. If sovereigns at war have agreed on a cartel for the exchange or ransom of prisoners, they are faithfully to observe it no less than every other convention; but if, as was formerly the general practice, the state leaves to every prisoner, at least during the war, the care of redeeming himself, such particular conventions offer many questions, of which some of the principal are the following. He who has acquired a lawful right of demanding a ransom from his prisoner, may transfer his right to a third person. This was practised in the last ages. But as the person taking a prisoner is obliged, for the sake of his reputation, to treat him with justice and humanity, he is not to transfer his right, in an unlimited manner, to one who might probably abuse it. When he has agreed with his prisoner, concerning the price of the ransom, he may transfer the right to whom he pleases. On the conclusion of an agreement made with a prisoner for the price of his ransom, it becomes a perfect contract, and cannot be retracted from, under a pretence that the prisoner is discovered to be richer than was imagined; for there is no manner of necessity that he should be rated according to the wealth of a prisoner, because that is not the scale for measuring the right of detaining a prisoner of war. But it is natural to proportion the price of the ransom to the prisoner's rank and character; the liberty of an officer of distinction being of greater consequence than that of a private man, or inferior officer. If the prisoner has not only concealed, but disguised his rank, it is a forcible fraud, and gives a right for annulling the agreement. If a prisoner, having agreed on the price of his ransom, dies before payment, it has been queried whether this price be due, and whether the heirs are obliged to discharge it? Unquestionably, says Vattel, they are obliged to it, if the prisoner died in the possession of his liberty; for, from the moment of his release, in consideration of which he had promised a sum, this sum becomes due, and does not at all belong to his heirs; but if he had not

not obtained his liberty at the time of his death, it can be no debt to him, or to his heirs, unless the agreement was otherwise: and he is not reputed to have received his liberty, till he is absolutely permitted to depart free; when neither he whose prisoner he was, nor the sovereign, opposed his release and departure. If indeed he has only been permitted to take a journey for applying to his friends, or his sovereign, in order to obtain the means of ransoming himself, and he dies before he is possessed of his full liberty, before his final discharge from his parole, nothing is due for his ransom. If, after agreeing on the price, he is detained in prison till the time of payment, and he dies before, the debt is paid by his death, and does not affect his heirs; such an agreement on the part of him, who detains his prisoner, being no more than a promise of giving him his liberty for a certain sum paid down. A promise of buying and selling does not suppose the purchaser to pay the price of a thing, if it happen to perish before the bargain is concluded. But if the contract of sale be perfect, the purchaser shall pay the price of the thing sold, though it should happen to perish before the delivery of it, provided there was no fault or delay in the seller. For this reason, if the seller has absolutely concluded the agreement of the ransom, and from that time owns himself a debtor for the stipulated sum, remaining no longer as a prisoner, but for the security of the payment, his intervening death does not extinguish the debt: the ransom agreed on remains still due. If the agreement says, that the ransom shall be paid on a certain day, and the prisoner happens to die before that day, then the heirs are bound to discharge it; for the ransom was due, and the day was assigned, only, as the term for payment. Upon the same principles, strictly speaking, it follows, that a prisoner, released on condition of procuring the release or discharge of another, should return to prison, in case the latter happens to die before he could procure him his liberty. Such an unfortunate case, however, is entitled to regard, and equity seems to require that this prisoner should continue in the enjoyment of liberty, provided he pays a just equivalent; it being now out of his power to purchase it precisely at the price agreed on. If a prisoner fully set at liberty, after having promised, but not paid, his ransom, happen to be taken a second time, it is evident that, without being exempted from paying his first ransom, if he is willing to be set at liberty, he must pay a second ransom. On the contrary, though the prisoner has agreed for the price of his ransom, if before the execution of the compact, before he is set at liberty in virtue of it, he be retaken by his party, he owes nothing. It is here evidently supposed, that the finishing hand was not put to the compact, and that the prisoner had not acknowledged himself debtor for the rate of his ransom. He whose prisoner he was, had, as it were, only made him a promise of selling, and he had promised to purchase; but the purchase and sale had not actually passed into effect; the property was not actually transferred. The property belonging to a person does not pass to him who takes him prisoner, unless at the same time he seizes on such things. Of this there is no doubt, especially in our times of moderation, when prisoners of war do not fall into slavery. And even by the law of nature, the property of a slave's goods does not, without some other reason, pass to the master of a slave. There is nothing in slavery of which this can itself be the natural effect. If a man obtain a power over the liberty of another, does it follow that he has likewise a right over his property? Therefore, if an enemy has not stripped his prisoner, or the latter has found means to conceal something from his search, what he has preserved should belong to him, or he may employ it towards the

payment of his ransom. At present even prisoners are not always stripped. The death of a prisoner puts a period to the right of him who had taken him; therefore an hostage, given for the procuring of a person's liberty, is to be released the moment the prisoner expires; and if the hostage dies, the prisoner is not released by such death. The reverse of this is true, if one, instead of being an hostage for the other, had been substituted in his stead. Vattel's Law of Nations, b. iii. ch. 17.

Formerly it was a common practice to ransom British ships, when captured by an enemy, by delivering to the enemy what was called a ransom-bill, which secured to the captor the price agreed upon, and operated as a bill of sale of the ship and cargo to the original owners, and as a protection to the ship against other cruisers of the enemy during the remainder of the voyage. A hostage was delivered to the captor, for securing to him the punctual payment of the stipulated sum. This ransom-bill, independent of the hostage, was considered as a contract of the law of nations, and obligatory upon the owners, as well as upon the captain and hostage who signed it; and actions have been often brought upon them in our courts of common law. And where the ship or goods were insured, the amount of the ransom was usually taken to be the measure of the demand of the insured upon the underwriters, in respect of the capture. But this practice of ransoming ships captured by the enemy being found to operate more to the disadvantage than for the benefit of this country, it was thought proper at length to prohibit it altogether. And therefore by stat. 22 Geo. III. c. 25. § 1. it is enacted, that it shall not be lawful for any of his majesty's subjects to ransom, or to enter into any contract or agreement for ransoming, any ship or vessel belonging to any of his majesty's subjects, or any merchandizes or goods on board the same, which shall be captured by the subjects of any state at war with his majesty, or by any person committing hostilities against his majesty's subjects. By § 2. all contracts and agreements which shall be entered into, and all bills, notes, and other securities, which shall be given by any person or persons for ransom of any such ship or vessel, or of any merchandize or goods on board the same, shall be absolutely void in law, and of no effect whatever. And by § 3. a penalty of 500*l.* is given to the informer, for every offence against the act. This statute has put an end to all questions on the law of ransoms. Marshall's Treatise on the Law of Insurance, vol. ii.

In our *Law Books*, ransom is also used for a sum paid for the pardoning of some notorious crime.

Horn makes this difference between *ransom* and *amercement*, that ransom is the redemption of a corporeal punishment due to any crime.

It is never usual to assess a larger fine than a man is able to pay, without touching the implements of his livelihood, but to inflict corporal punishment, or a limited imprisonment, instead of such fine as might amount to imprisonment for life. And this is the reason why fines in the king's court are frequently denominated *ransoms*, because the penalty must otherwise fall upon a man's person, unless it be redeemed or ransomed by a pecuniary fine (Mirr. c. 5. § 3. Lamb. Eirenarch. 57.); according to an ancient maxim, "qui non habet in crumena luat in corpore." Yet, when any statute speaks both of fine and ransom, it is holden, that the ransom shall be treble to the fine at least. Dyer. 232.

RANSTADT, in *Geography*, a town of Germany, in the principality of Stolberg; 17 miles N.E. of Frankfort on the Maine.

RANSTADT, or *Mark Ransstadt*, a town of Saxony, in the

the territory of Merseburg; 10 miles S.S.E. of Merseburg. N. lat. $51^{\circ} 18'$. E. long. $12^{\circ} 14'$.

RANT, in the *Drama*, an extravagant flight of passion, overshooting nature and probability.

Leo's tragedies abound with rants; yet the wildest of them, it is observed, have frequently met with applause on the stage.

We find instances of rants, even in our severest poets. Such, *e. gr.* is that in the beginning of Ben Johnson's Cataline, where the parricide, in speaking to Rome, says, "I'd plow up rocks, steep as the Alps in dust; and lave the Tyrrhene waters into clouds, but I would reach thy head!"

RANTAMPOUR, in *Geography*, a circar of Hindoostan, in the country of Agimere, bounded on the N. by Jyenagur, on the E. by Agra, on the S. by Kottah, and on the W. by Oudipour and Sirowy.—Also, a town and fortress, being the capital of the above named circar; 86 miles E. of Agimere. N. lat. $28^{\circ} 35'$. E. long. $76^{\circ} 58'$.

RANTZAU, JOHN, in *Biography*, a general in the Danish service, was born in 1492, and at the age of 13 he entered into the army. In 1515 he began to travel into foreign countries, visiting in succession England, Spain, Germany, Italy, Greece, Syria, Palestine, and other parts of the East. In 1517 he was knighted at Jerusalem; and upon his return to Denmark, was appointed to accompany duke Christian, afterwards Christian III., on his tour to Brandenburg, and other towns of Germany. When Frederic I. accepted the crown of Denmark, he was promoted to be a general in 1553, and entrusted with the command of the troops in Holstein. He became greatly distinguished in his military character, and on various diplomatic concerns, and died in 1565. As an author he is known by the following works: "A true and brief Account of the Wars carried on in 1559, by Frederic king of Denmark, and Adolphus duke of Holstein," &c.; "Descriptio Cimbriz," printed in Westphalen's Monumenta inedita, tom. i. Gen. Biog.

RANTZAU, in *Geography*, a county of Germany, in the duchy of Holstein, about ten miles long and six broad. It takes its name from a feat seven miles N. of Eutyn.

RANTZEN, a town of the duchy of Stiria; 6 miles N.W. of Muckrau.

RANTZENBACH, a town of Austria; 6 miles S.S.W. of St. Polten.

RANVILLE, a town of France, in the department of the Calvados; 5 miles N.E. of Caen.

RANULA, dim. of *rana*, a frog. This term is, in *Surgery*, applied to a swelling of the salivary ducts under the tongue. Whether the tumour is so named from a whimsical supposition that it bears a resemblance to a frog, or from its being fancied to oblige the patient to make a croaking noise, in attempting to articulate, is a point which surgical writers leave undetermined. The swelling is round, of a greyish colour like an hydatid, soft, compressible, indolent, and, in the early stage, almost transparent. At first, it is of about the same size as a nut, or cherry; but, by degrees, its volume becomes much more considerable. It is very frequently met with in young children: its occurrence in adults is more uncommon. It consists of a successive dilatation of the excretory tube of the submaxillary, or else of the sublingual gland, the orifice of which duct is by some cause or another stopped up, or obliterated; so that the confined saliva accumulates, becomes viscid, and ceases to flow in the usual manner. In proportion as the ranula increases, the incipient state of it having been neglected, its enlarged size raises up the tongue, and forces it backward;

the consequence of which is, that mastication, deglutition, and respiration, are obstructed. The voice becomes indistinct, and hoarse; the motion of the tongue is restrained: this organ cannot be put out of the mouth. By degrees, the incisor and canine teeth of the lower jaw are loosened; the layer of muscles, composing the lower parietes of the mouth, is depressed; and the swelling, having attained a considerable size, makes a very manifest prominence beneath the chin. In this advanced stage, that is to say, when the ranula has existed ten or twelve years, as practitioners occasionally see instances of, the appearance of the swelling is quite altered from what it originally was. The tumour is now hard, elastic, painful, ulcerated, and, as it were, sarcomatous: it is as large as a turkey's egg, and not situated at the side of the frænum, but anteriorly under the tongue, to which it is closely adherent. The mouth emits a very fetid smell; and the breathing is so much obstructed, that the patient, through fear of suffocating, is obliged to lie with his mouth wide open, when he goes to sleep.

While a ranula is recent, the fluid which it contains is a viscid saliva, resembling the white of egg, and sometimes of rather a yellow colour. In time it is gradually changed, becoming turbid and puriform; and, in certain instances, soft, friable, greyish concretions, from the size of a pea to that of an almond, commonly called salivary calculi, are found in the kind of cyst, which is produced by the dilatation of the salivary duct. These calculi essentially consist of a large proportion of the phosphate of lime, united with a mucilaginous substance; and concretions of the same kind frequently occur in the tonsils, and in the salivary glands themselves, as well as their excretory ducts. Forcstus, lib. xiv. obs. 26. p. 112. Blegney, Nouvelles Découvertes, &c. tom. i. ann. 1679, p. 230. Mém. de l'Acad. de Chirurgie, tom. v. p. 464. Petit, Œuvres Posthumes, &c. tom. i. p. 188. Blasius, Obs. 14. p. 81.

A ranula, whether recent or inveterate, cannot be cured except by a surgical operation. The curative indication, in the first of these states, is to make an outlet for the fluid accumulated in the tumour, and to make an opening sufficiently capacious to let the saliva readily pass into the mouth. Merely making an incision into the swelling, or opening it with a trocar, or a seton drawn through it, are stated to be ineffectual methods. The tumour does indeed subside as soon as the aperture is made; but the edges of the wound grow together again, and the disease recurs. There is an absolute necessity for first making an incision the whole length of the swelling, and then removing, with the aid of scissors and a pair of dissecting forceps, a portion of the edges of the recent wound. This slight loss of substance prevents the return of the complaint, and always insures a free passage for the saliva; an advantage of which there is no certainty in any other mode of proceeding. By this slight operation, ranulae in children may be cured in the course of a few days, without the least occasion for the application of any dressings whatsoever. It has been proposed to dilate the contracted orifice of the salivary duct with a probe. (Mém. de l'Acad. de Chirurgie, tom. iii. p. 460.) But this orifice is difficult of detection, and the swelling cannot be in this manner easily emptied. M. Lassus seems to entertain doubts whether Warton's canal can ever be made to resume its original state, after once being closed. Pathologie Chirurg. tom. i. p. 405.

When a ranula has existed a long while, is attended with considerable hardness, and is of large size, it is a tumour which requires to be completely extirpated. A transverse incision, parallel to the opening of the mouth, is to be made in it through its whole extent. The surgeon is then to cut

out the upper portion of the swelling, situated in front of the frænum of the tongue, to which it is also adherent, and next the inferior portion, which sometimes extends into the interspace betwixt the genio-hyoidei and genio-glossi muscles, with which it becomes confounded. A pair of forceps, a hook, scissors, and a straight bistoury, are the instruments necessary for this operation. A degree of hemorrhage always ensues. The use of a detergent gargle, made of barley-water and honey of roses, will serve to finish the cure in a very moderate space of time.

In confirmation of the latter observation, Læssus adduces the following case. A young man, aged 22, had a ranula, which had continued ever since he was born, and was equal in size to a turkey's egg. The incisor teeth of the lower jaw were loosened, and forced forward by the successive increase of the swelling. A seton had been passed quite through it, without any useful effect. The breath of the patient and his saliva were intolerably fetid. The tumour was closely adherent to the lower and anterior part of the tongue; and extending laterally, confounded itself with this organ, of which it impeded the motion. A straight, narrow bistoury was introduced into one of the openings at the side of the tumour, and carried completely across to the opposite aperture. Thus a transverse incision was made into the cavity of the disease. By means of the same instrument and a hook, the lateral portions of the swelling were removed. A profuse hemorrhage ensued, caused by the total division of the frænum, the raninal veins, and one of the raninal arteries. It was stopped by putting under the tongue a large quantity of dry lint, and by compressing the dorsum of the tongue several hours with the fingers, while the thumb was employed in compressing the part behind the chin from below upwards. This double sort of pressure answered the purpose. No cautery was found necessary, and, by the use of detergent gargles, the patient was cured in about a fortnight.

When a ranula of long duration, situated at the side of the tongue, and of considerable size, forms a tumour, that makes its appearance outwardly towards the base of the jaw, Læssus seems to disapprove of making a free incision through the skin, for the purpose of extirpating that part of the swelling which cannot be removed through the mouth; a plan which was, in one instance, practised by Marchettis. Obs. Med. Chirurg. obs. 31. p. 48. See Læssus' Pathologie Chirurgicale, tom. i. chap. 61.

RANULARES, in *Anatomy*. See RANINA.

RANUNCULACEÆ, in *Botany*, the 61st natural order in Jussieu's system, or the first of his 13th class, for whose character see GERANIA. The *Ranunculaceæ* are defined as follows.

Calyx of many leaves, sometimes wanting. *Petals* definite, mostly five. *Stamens* indefinite, except in *Myosurus*; their anthers incorporated with the filaments. *Germens* several, indefinite or definite, rarely solitary, placed on a common receptacle; each of them furnished with a style, which is rarely wanting, and a simple stigma. *Capsules*, or rarely *berries*, as many as the germens; in some instances single-seeded, and not bursting; in others many-seeded, splitting half way down, at their inner margin, into two valves, bearing the seeds at the edges. *Coraculum* minute, lodged in a cavity at the upper part of the large horny *albumen*. *Stem* generally herbaceous. *Leaves* alternate; rarely (in *Clematis* and *Atragene*) opposite; some of them half sheathing the stem; some compound, pinnate or fingered; some, as is more frequently the case, simple, and these are mostly palmate or lobed, their sinuses often pale at the base. See RANUNCULUS.

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Jussieu divides the order in question into four sections.

Sect. 1. *Capsules single-seeded, not bursting; berries in Hydrastis.*

This section consists of *Clematis*, *Atragene*, *Thalictrum*, *Hydrastis*, *Anemone*, *Hamadryas* of Commerçon, *Adonis*, *Ranunculus*, *Ficaria*, and *Myosurus*.

Sect. 2. *Capsules many-seeded, splitting at the inner edge. Petals irregular.*

The calyx in this section is often coloured, being what Linnæus terms corolla; that author considering the petals of Jussieu as nectaries. The genera are *Trollius*, *Helleborus*, *Isopyrum*, *Nigella*, *Gerardella*, *Aquilegia*, *Delphinium*, and *Aconitum*. Some species of *Delphinium* have but a single capsule.

Sect. 3. *Capsules many-seeded, splitting at the inner edge. Petals regular.*

Caltha, *Paonia*, *Zanthorrhiza*, *Cimicifuga*.

Sect. 4. *Germen solitary. Berry of one cell, with many seeds, affixed to a single lateral receptacle.*

The only genera are *Adæa* and *Podophyllum*, and these we feel disposed to remove to Jussieu's next order, PAPAVERACEÆ. See that article.

We cannot but remark that the *petals*, as Jussieu terms them, in *Trollius* and *Helleborus* are by no means definite, and that they greatly exceed the number five. Neither are they irregular in *Trollius*. As to the other genera of his 2d section, the parts in question are such obvious nectaries, that they can have no other function to perform, except possibly in *Aquilegia*, where their limb partakes of the nature of petals.

RANUNCULOIDES, a genus of Vaillant's, founded on the *Ranunculus hederaceus* and *aquatilis* of Linnæus, and named from its resemblance or affinity to RANUNCULUS; see that article. No one has followed Vaillant in this instance, nor is there any real mark of distinction for his supposed genus. *Ranunculoides* is, besides, the specific name of a rare British *Anemone*, but *ranunculina* would have been better Latin; as in *Helleborus ranunculinus*, Sm. Pl. Ic. fasc. 2. t. 37. Willd. Sp. Pl. v. 2. 1336. See HELLEBORUS.

RANUNCULUS, an ancient name, whose origin is as obvious as its sense is obscure. The word is, no doubt, derived from *rana*, and means a little frog. The Greeks call the same plant βαλεαχιον, which is nearly synonymous. Most etymologists suppose this name to allude to the native situation of the plant, in bogs and watery places, such as frogs frequent. But the original βαλεαχιον of Dioscorides is the beautiful *Ranunculus asiaticus* of Linnæus, or Garden Ranunculus, which inhabits corn-fields, and does not grow in wet places; though indeed the other three species, described by that ancient writer, do; these are our *lanuginosus*, *muricatus*, and *aquatilis*. It seems possible that the divisions of the leaves in all these plants may have suggested the idea of a frog's foot, which supposition is confirmed by the English name, Crowfoot. Ambrosinus hints at a resemblance between the root and the foot of a frog, which is not, to us, by any means apparent.—Linn. Gen. 281. Schreb. 377. Willd. Sp. Pl. v. 2. 1307. Mart. Mill. Dict. v. 4. Sm. Fl. Brit. 587. Prodr. Fl. Græc. Sibth. v. 1. 380. Ait. Hort. Kew. v. 3. 351. Pursh v. 2. 391. Juss. 233. Poiret in Lamarck Dict. v. 6. 97. Lamarck Illustr. t. 498. Gært. t. 74. (Ficaria; Dill. Gen. 108. t. 5. Hudf. Angl. 244. Juss. 233. Ranunculoides; Vaill. Mem. de l'Acad. des Sciences for 1719, German edition, 321.)—Class and order, *Polyandria Polygynia*. Nat. Ord. *Multifloræ*, Linn. *Ranunculaceæ*, Juss.

Gen. Ch. *Cal.* Perianth of five ovate, concave, some-

what coloured, deciduous leaves. *Cor.* Petals five, obtuse, polished; with small claws. Nectary a cavity in each petal, just above the claw. *Stam.* Filaments very numerous, half the length of the corolla; anthers firmly united therewith, erect, oblong, obtuse, of two separate lobes. *Pist.* Germens numerous, collected into a head; styles none; stigmas reflexed, very small. *Peric.* none. *Receptacle* beset with extremely minute stalks, to which the seeds are attached. *Seeds* numerous, naked, irregular, uncertain in figure, with a reflexed point.

Obf. The essential mark of this genus consists, as Linnæus remarks, in the nectary, the rest of the parts being uncertain; hence he takes occasion to point out the use of adverting to that organ, which before his time had been neglected, and which his opponents accuse him of sometimes making of too much importance. The great Jussieu will not, in this obvious case, use the language, though he adopts, unacknowledged, the idea of Linnæus; nor will he allow the manifest nectaries of some of his *RANUNCULACEÆ* (see that article) to be other than petals. "Such," to use his own words, in his preface, p. 26, "is the love of undivided praise!"

The nectary in *Ranunculus*, says Linnæus, is, in some species, a naked pore; in some it is bordered with a cylindrical margin; in others closed with a notched scale. *Ficaria* of authors has only a three-leaved calyx, with a superabundance of petals. The seeds in some species are roundish; in others depressed, prickly, and fewer in number. *R. hederaceus* has but five stamens; *salicatus* has a sword-shaped point to each seed, and appendages to the base of the calyx; *federatus*, and a few besides, have an awl-shaped receptacle, and consequently a spiked fruit.

Eff. Ch. Calyx of five leaves. Petals from five to eight, with a honey-bearing pore in the claw of each. Seeds naked.

This extensive genus is divided into two sections, by the form of the leaves. The species are all herbaceous, generally of an acrid quality. The prevailing colour of the flowers is yellow; we know of none that are blue, except by accidental variation in *R. asiaticus*. They are plants of temperate or cold climates; some of them alpine. Linnæus, in *Sp. Pl.* ed. 2, enumerates twenty-eight species; the 14th edition of *Syst. Veg.* has forty-four, and Willdenow reckons up sixty-one. Fifteen are natives of Britain, as mentioned in *Fl. Brit.*; but the 11th species in that work, *parvulus* of Linnæus, must be expunged, as a mere variety of *hirsutus*, n. 8. The original number is, however, made up, by a new-discovered Scottish species, the *alpestris*, figured in *Engl. Bot.* v. 34. t. 2390.

So many additions have been made to this genus by the labours of Poiret in Lamarck's *Dict.* v. 6, and the discoveries of Michaux and Pursh, that, with some necessary corrections, and a few communications of our own, the whole subject requires to be detailed.

Sect. 1. Leaves simple and undivided.

1. *R. Flammula.* Lesser Spear-wort. *Linn. Sp. Pl.* 772. *Willd. n. 1. Ait. n. 1. Fl. Brit. n. 1. Engl. Bot. t. 387. Curt. Lond. fasc. 6. t. 37.* (*R. flammeus minor*; *Ger. Em.* 961, and *R. flammeus ferratus*; *ibid.* 962.)—Leaves ovato-lanceolate, bluntish, stalked. Stem declining.—Native of watery places throughout Europe, flowering most part of the summer. Root perennial, of long simple fibres. Herb shining, not quite smooth, very various in size and luxuriance. Stems spreading in every direction, round, leafy, hollow. Leaves many-ribbed, either entire or variously ferrated. Flowers numerous, solitary, on long stalks, of a bright golden yellow, half an inch or

more in diameter. The whole plant is of an excessively acrid burning quality, said to produce inflammation in the viscera of sheep, whence the name *flammula*, a little flame. Dr. Withering recommends the distilled water, as preferable to all other medicines, for procuring instantaneous vomiting in cases of poison.

2. *R. reptans.* Creeping Spear-wort. *Linn. Sp. Pl.* 773. *Fl. Lapp. ed. 2. 198. t. 3. f. 5. Lightf. 289; fig. in frontispiece to v. 1. Fl. Dan. t. 108.*—Leaves linear-lanceolate. Stem creeping.—About the margins of alpine lakes, on a sandy soil; common in Scotland, flowering in June and July. We have always thought this a variety of the former, as mentioned in *Fl. Brit.*; but Willdenow contends for the contrary. He truly asserts that it differs in having a thread-shaped creeping stem; linear entire leaves, tapering down into their footstalks; flower-stalks solitary, erect, single-flowered; and much smaller flowers. Nevertheless, we have seen so many intermediate varieties, and such a disposition in weak plants of the *Flammula* to take root at their joints, that we most incline to our original opinion, suggested first by Linnæus himself in his *Sp. Pl.*

3. *R. Lingua.* Great Spear-wort. *Linn. Sp. Pl.* 773. *Willd. n. 3. Ait. n. 3. Fl. Brit. n. 2. Engl. Bot. t. 100. Fl. Dan. t. 755.* (*R. flammeus major*; *Ger. Em.* 961. *R. longifolius*, *lingua Plinii dictus*, *foliis ferratis*; *Ambros. Phyt.* 459.)—Leaves lanceolate, pointed. Stem erect, many-flowered. In marshes and muddy ditches, chiefly in the northern parts of Europe; rare in England; flowering in July. Thrice the size of *R. Flammula*, and quite erect. Leaves more nearly sessile, and taper-pointed; occasionally ferrated, as in the rude cut of Ambrosinus, but not commonly so. Calyx hairy. The whole herb is more or less covered with close-pressed hairs, visible also in *Flammula*. Flowers large and brilliant, very conspicuous.

4. *R. nodiflorus.* Knot-flowered Crowfoot. *Linn. Sp. Pl.* 773. *Willd. n. 4. Ait. n. 4. Walld. et Kitaib. Hung. v. 2. 192. t. 176. Ait. (R. parisiensis pumilus, plantaginellæ folio; Petiv. Gazoph. v. 1. 6. t. 25. f. 4. Vaill. Mem. de l'Acad. for 1719, Germ. ed. 324. t. 17. f. 4. R. ficulus, &c.; Petiv. Gaz. t. 24. f. 9, is a variety.)*—Leaves ovate, stalked. Flowers sessile.—In marshy places about Paris; also in Sicily; flowering in summer. A small, smooth, annual plant, varying in luxuriance, and having much the appearance of *Limnæa aquatica*. Leaves about an inch long, various in breadth, on very long stalks. Flowers small, solitary, sessile, axillary. Seeds taper-pointed.

5. *R. fliformis.* Slender Creeping Crowfoot. *Michaux Boreal-Amer. v. 1. 320. Pursh n. 4. Lamarck Dict. n. 4.*—"Stem thread-shaped, creeping, jointed, almost naked. Leaves linear-awlshaped, obtuse. Flowers axillary, solitary, stalked."—In inundated places, on the banks of the river St. Lawrence; at Hudson's bay and Labradore; flowering in June and July. This is described as a very small, slender, smooth species, very much resembling *R. reptans*, n. 2. We have seen no specimen.

6. *R. pusillus.* Diminutive Crowfoot. *Pursh n. 3. (R. Flammula; Walt. Carol. 159. Michaux Boreal-Amer. v. 1. 321; according to Pursh.)*—"Smooth. Leaves stalked; lower ones ovate, toothed; upper linear-lanceolate, toothed at the end; uppermost linear, like bractæas. Stalks alternate, solitary, single-flowered."—Native of North America. Perennial, flowering from June to August. A small species, with exceeding small flowers. Petals pale yellow. *Pursh.* A specimen from Kalm, unnamed, in the Linnæan herbarium, answers nearly to the above characters, and yet seems a variety of *R. abortivus*, hereafter mentioned.

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7. *R. gramineus*. Grassly Crowfoot. Linn. Sp. Pl. 773. Willd. n. 5. Ait. n. 5. Fl. Brit. n. 3. Engl. Bot. t. 2306. Curt. Mag. t. 164. Bulliard. t. 123.—Leaves linear-lanceolate, glaucous, many-ribbed, sessile. Stem erect, very smooth throughout, with few flowers. Fruit globose.—Native of mountainous situations in the south of France. *Gerard*. In Italy, Column. Ecphr. 314. Withering says it was brought from North Wales by Mr. Pritchard. Willdenow mentions moist meadows in France as its native station, for which we can find no authority. The plant thrives in England in rather dry gardens, flowering in May or June, and is perennial. The grassy, broadish, glaucous leaves, and large golden flowers, readily distinguish this species. The root is tuberous and round. Stem twelve or eighteen inches high. Calyx very smooth, spreading, not deflexed. The fruit is described as globose. We have not seen it ripe.

8. *R. pyrenæus*. Pyrenean Crowfoot. Linn. Mant. 248. Willd. n. 6. Jacq. Misc. v. 1. 154. t. 18. f. 1. (*R. pumilus*, *gramineis foliis*; Bauh. Hist. v. 3. append. 850. *R. n.* 1180; Hall. Hist. v. 2. 77.) β . *R. plantaginicus*; Allion. Pedem. n. 1445. v. 2. 48. t. 76. f. 1.—Leaves linear-lanceolate, many-ribbed, stalked. Stem erect, with one or two flowers; woolly at the top. Fruit somewhat cylindrical. Seeds with recurved beaks.—Native of the Pyrenæes, as well as of the Alps of Switzerland, Dauphiny, and Carinthia. Linnæus, for a long while, confounded this with the last, and many botanists have considered them as hardly to be distinguished, but by the colour of the flowers. The leaves of the present vary greatly in breadth, being sometimes quite narrow and linear; but in variety β they are elliptical, and an inch wide. They appear to be green, not glaucous. The upper part of the stem, quite smooth in *R. gramineus*, is always hairy, and under the flower is densely woolly, in the present species. The petals are pure white. Fruit nearly cylindrical. Seeds with elongated, remarkably recurved, points. Few plants vary more in luxuriance.

A most remarkable variety, as Haller and Villars esteem it, is the *R. lacerus*, Bellardi Append. ad Flo. Pedem. 27. t. 6, of which we have a specimen from the author himself. In this the stem is branched, bearing thirteen or fourteen flowers, but its chief singularity consists in the jagged, and partly almost palmate, leaves, which nevertheless bear all the marks of casual luxuriance. We have a specimen of Allioni's *plantaginicus*, our variety β , which, by a tooth or two in some of the leaves, evinces an approach towards this *lacerus*; and we have another of the same with four flowers on one stem.

9. *R. parnassifolius*. Parnassia-leaved Crowfoot. Linn. Sp. Pl. 774. Willd. n. 7. Ait. n. 6. Curt. Mag. t. 386. Wulf. in Jacq. Coll. v. 1. 191. t. 9. f. 3, without leaves. (*R. n.* 1179; Hall. Hist. v. 2. 77. Herb. Davall.)—Leaves many-ribbed; radical ones roundish-ovate, somewhat heart-shaped, on long stalks; stem-leaves ovato-lanceolate, pointed, sessile.—Native of the Alps of Switzerland, Dauphiny and Carinthia, as well as of the Pyrenæes, from all which countries we have received specimens. The plant is esteemed very rare, and Wulfen regrets that he lost the root and leaves of his only specimen; so that Mr. Curtis has rendered a valuable service to botanists by his excellent figure. This is a singularly elegant species, on account of its leaves, which resemble our *Parnassia*, as well as for its large and brilliant white flowers, with their rose-coloured calyx. Their stalks are woolly. Fruit ovate. Seeds obovate, obtuse, with short incurved beaks. The root is perennial, formed of copious, very long, pale fibres, as if it grew in watery places, but Haller says it inhabits stony alpine situations, being quite common in his own territory of Aigle.

10. *R. ophioglossifolides*. Serpent's-tongue Crowfoot. Willd. n. 8. (*R. ophioglossifolius*; Villars Dauph. v. 3. 731. t. 49.)—Stem simple, erect, leafy. Lower leaves ovate, or heart-shaped, many-ribbed, on long stalks; upper linear-lanceolate, sessile.—Found between Toulon and Hyères in Provence, by M. Villars, who mentions having seen a drawing of the same plant, in the royal collection at Paris, marked *R. lefbius palustris*, *ophioglossi folio*; Tourn. Cor. 20. The root is described by Villars as somewhat bulbous, or tuberous, with many whorls of fibres. Stem erect, a foot high. Leaves smooth, rather fleshy. Flowers small, yellow, with shining petals. Seeds in a small round head. He conceives it somewhat allied to *R. Flammula*. The resemblance of the leaves, in his plate, to *parnassifolius*, seems to have induced Willdenow to range it here. We have seen no specimen.

11. *R. amplexicaulis*. Plaintain-leaved Crowfoot. Linn. Sp. Pl. 774. Willd. n. 9. Ait. n. 7. Curt. Mag. t. 266. (*R. folio plantaginis*; Ger. Em. 963.)—Leaves ovate, pointed, glaucous, clasping the many-flowered stem. Root fasciculated.—Native of the Apennine and Pyrenean mountains, but not, as far as we know, of the Swiss Alps, Haller having mistaken his n. 1179, which is *parnassifolius*, for this species. It is a hardy perennial in our gardens, not difficult of culture, yet not common, flowering in May. The herbage is glaucous. Stem erect, leafy, twelve or fifteen inches high, branched above. Leaves generally more or less fringed with soft hairs. Calyx green, smooth, concave, partly membranous and white at the edge. Petals of a pure and brilliant white. Anthers yellow, as in other species. We have never seen the ripe seeds.

12. *R. heterophyllus*. Various-leaved Slender Crowfoot. (*R. bonariensis*; Lamarck Dict. n. 9.)—Leaves stalked, toothed, heart-shaped or ovato-lanceolate, with three central ribs. Stem erect. Flowers stalked, solitary, opposite to the leaves. Seeds obtuse, granulated.—Gathered by Commerçon at Buenos Ayres, in marshy places. Root fibrous. Stem erect, a foot or more in height, slender, smooth, striated, branched, leafy. Leaves alternate, on long stalks; the lower ones ovate, or heart-shaped; the upper lanceolate, or ovate; all obtuse, more or less crenate or toothed, about an inch long, smooth, furnished with three central ribs, and several lateral branching veins. Footstalks bordered at their base; the lowermost much the longest. Flowers very small, whitish, on solitary, straight, simple, lateral stalks, an inch or an inch and half long, opposite to the leaves. Fruit ovate. Seeds obtuse, or obovate, rough with minute points. The calyx is smooth and reflexed, often remaining till the seeds are ripe.

13. *R. flagelliformis*. Long-stalked Crowfoot.—Leaves on long stalks, heart or kidney-shaped, wavy or crenate. Stem creeping, thread-shaped. Flowers stalked, solitary, opposite to the leaves. Petals ovate. Seeds obtuse, dotted.—Native of Chili and New Granada. We have specimens from Mutis and Cavanilles, but this species does not seem to be any where described. The stems are long, thread-shaped, much branched, prostrate, creeping or perhaps floating, sending out from each joint long fibrous radicles, and one or more smooth, roundish, heart-shaped or kidney-shaped leaves, hardly an inch wide; their footstalks measuring from two to three inches. Flowers very small, white, solitary, opposite to the leaves, on slender stalks, rather shorter than those of the foliage. Stamens few. Fruit rather oblong. Seeds obovate, obtuse, compressed, minutely dotted. This *Ranunculus* is perhaps most nearly akin to our British *hederaceus*, hereafter described, though very certainly distinct, and as the species are at present arranged, they must remain

at a distance. In habit and general resemblance they closely accord.

14. *R. Cymbalaria*. Small Trailing Crowfoot. Pursh n. 5.—“Leaves heart or kidney-shaped, with five blunt teeth. Stem creeping, thread-shaped. Flower-stalks solitary, mostly two-flowered. Petals linear. Fruit oblong.”—In saline marshes, near the salt works of Onondago, New York, flowering in June and July. Perennial, somewhat resembling the following. *Flowers* small, pale yellow, sometimes white. *Pursh*.

15. *R. falsuginosus*. Salt-marsh Crowfoot. “Pallas’s Travels, small edition, v. 3. 173.” Willd. n. 11. (*R. ruthenicus*; Jacq. Hort. Vind. v. 3. 19. t. 31. *R. repens*, flore in caule singulari, foliis variè fectis; Amm. Ruth. §1. t. 13. f. 2.)—Leaves ovate, somewhat heart-shaped; toothed at the extremity. Stem creeping, thread-shaped. Flower-stalks solitary, mostly single-flowered. Petals obovate. Fruit nearly globose.—Found by Gmelin, on the banks of the Neva; *Ammann*; by Pallas in the salt plains of Siberia, beyond the lake Baical. The *flowers* are yellow, as big as our common Crowfoots, being more than ten times the size of the last. Their *petals* are about ten, obovate. The *root* sends out long runners, like a garden strawberry. Gmelin’s specimen is much smaller than Jacquin’s figure.

16. *R. bullatus*. Portugal Crowfoot. Linn. Sp. Pl. 774. Willd. n. 10. Ait. n. 8. (*R. lusitanicus*; Dod. Pempt. 429. *R. autumnalis* Clusii; Ger. Em. 954. *R. lusitanicus* Clusii; ib. 955.)—Leaves ovate, ferrated. Flower-stalks radical, single-flowered, hairy.—Native of Portugal and the north of Africa, cultivated in England before 1640, but now scarcely seen. It flowers in May and June, and has a perennial fibrous root, more like Gerarde’s fig. 10 than 11. *Leaves* all radical, stalked, ovate, ribbed and veiny, somewhat hairy, strongly and unequally ferrated, an inch or an inch and half long; sometimes, according to Clusius, blistured. *Flowers* yellow, on simple, hairy, upright, radical stalks, three or four inches long. *Petals* more than five, narrow-obovate. The old authors delineate two kinds, generally supposed to be varieties, but which may possibly be species. We have not seen either, except in a dried state.

17. *R. Ficaria*. Pilewort, or Lesser Celandine. Linn. Sp. Pl. 774. Willd. n. 12. Ait. n. 9. Fl. Brit. n. 4. Engl. Bot. t. 584. Curt. Lond. fasc. 2. t. 39. Mart. Rust. t. 21. Bulliard t. 43. (*Chelidonium minus*; Matth. Valgr. v. 1. 578. Fuchf. Hist. 867. Ger. Em. 816.)—Leaves heart-shaped, angular, smooth, stalked. Petals numerous.—Native of waste ground throughout Europe, in moist, shady, or bushy places, flowering in the early spring. Dr. Sibthorp found it common in Greece; and there can be no doubt of its being, as all botanists have judged, *χελιδονιον το μικρον*, the Lesser Celandine, of Dioscorides. Root perennial, fibrous, with many fleshy, pear-shaped, annual knobs, whose appearance gave rise to the Latin, as well as English, name of this species, and to an idea that the plant might be serviceable in the piles, which those who believe, may consult Gerarde for the mode of application. The *stems* are leafy, and mostly single-flowered. *Leaves* smooth and shining. *Flowers* stalked; with three, sometimes five, leaves to the *calyx*; and eight, occasionally ten, elliptic-oblong, highly polished *petals*, which fade to white in bright sunshine.

18. *R. frigidus*. Alpine Siberian Crowfoot. Willd. n. 13.—Radical leaves wedge-shaped-ovate, five-toothed at the extremity; those of the stem sessile, palmate.—Native of the alps of Siberia. Willdenow says he received this by the name of *gracilis*, meaning *glacialis*, “with which it agrees

in the size, and perhaps colour, of the *flower*, but is abundantly distinct in the *leaves*.” Several Siberian unnamed specimens, in the Linnæan herbarium, answer exactly to Willdenow’s description. The radical leaves are several, stalked, between half an inch and an inch in length, smooth; rounded and entire at the base; abrupt and variously cut into broad blunt teeth, we might almost say lobes, at the summit. Stem erect, usually single-flowered, with two or three, alternate, sessile, more deeply lobed, or palmate, *leaves*. *Calyx* brown, hairy. *Petals* five, inversely heart-shaped, apparently white. The *flower* is so like *glacialis*, that we cannot but suspect the difference of the *leaves*, however great, to be but casual. At any rate, they are sometimes so deeply cut, that this species might perhaps, without violence, have been placed in the following section, next to *glacialis*.

19. *R. Thora*. Kidney-leaved Crowfoot. Poison-root of the Swifs. Linn. Sp. Pl. 775. Willd. n. 14. Ait. n. 10. Jacq. Austr. t. 442. Obs. fasc. 1. 25. t. 13. (*Thora major et minor*; Camer. Epit. 825, 826. Th. valdensis, et montis Baldi; Ger. Em. 966. Pseudoaconitum pardalianches; Matth. Valgr. v. 2. 430.)—Leaves kidney-shaped, abrupt, crenate, reticulated; the radical ones on long stalks. Stems with one or two flowers. Bractæas lanceolate.—Native of the alps of Switzerland, Austria, and Greece, as well as of mount Baldus, near Verona, flowering rather early in summer. It is said to have been formerly in the English gardens, but has never fallen under our observation. Root perennial, of thick, tapering, fleshy fibres or rather knobs. Stem solitary, smooth, simple, near a span high; terminating in one, rarely more, long-stalked golden *flowers*, about half an inch wide; its *calyx-leaves* lanceolate, coloured, smooth, like every other part of the plant. *Leaves* about two inches wide, and one long, rather coriaceous, strongly reticulated with veins, neatly crenate, terminating either abruptly, with a notch, or elongated into three acute, entire, triangular, central lobes; the uppermost, or floral, ones, lanceolate and entire; the radical ones only on long slender stalks. Fruit globular, of a few, large, tumid, ovate seeds, with hooked points. The root of this plant is reported to be extremely acrid and poisonous, its juice having been used formerly, by the Swifs hunters of wild beasts, to envenom their darts, whose wound by that means becomes speedily fatal and incurable. Hence the name, from *ζηλορ*, *corruption*, or *venom*. We can see no possible reason for distinguishing the greater and smaller kinds, even as permanent, or well-marked, varieties.

Section 2. *Leaves dissected and divided*.

20. *R. creticus*. Cretan Crowfoot. Linn. Sp. Pl. 775. Willd. n. 15. Ait. n. 11. (*R. creticus latifolius*; Clus. Hist. v. 1. 239. Ger. Em. 963.)—*R. macrophyllus*; Desfont. Atlant. v. 1. 437. Lamarck Dict. n. 19.—Radical leaves kidney-shaped, crenate, somewhat lobed; stem-leaves in three deep, lanceolate, entire segments. Stem many-flowered.—Native of Crete; cultivated in the Oxford garden in 1658, but perhaps now lost. The root is perennial, of many thick, tapering, fleshy fibres. Stem thick, moderately branched, eighteen inches, or more, in height, hairy as well as the rest of the herbage. Radical leaves from two to four inches long, and more in breadth, kidney-shaped, reticulated with strong veins, light green, downy, unequally divided into about seven three-cleft, or coarsely notched, shallow lobes; stem-leaves alternate, in three deep, oblong, obtuse, entire lobes; the base tapering or wedge-shaped. *Flowers* several, yellow, nearly as large as *R. Lingua*, n. 3. *Calyx* reflexed, ovate, loosely hairy. *β* appears, by the account of M. Desfontaines, to differ merely in having the lower

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lower leaves more deeply lobed than usual, and somewhat less hairy.

21. *R. cassubicus*. Cassubian Crowfoot. Linn. Sp. Pl. 775. Willd. n. 16. Ait. n. 12. (*R. aconitifolius*, folio rotundo, ad radicem præstolante; Loef. Pruss. 225. t. 72.)—Radical leaves roundish-heart-shaped, crenate, undivided; stem-leaves in several deep, lanceolate, toothed and jagged segments. Stem many-flowered.—Native of Prussia and Siberia, flowering in May. Mellrs. Loddiges are said to have introduced it into England, in 1794. Though the character of this approaches the last, the two plants are very different. The radical leaves of the present, though heart-shaped, are almost orbicular, their two lobes meeting each other; their margin sharply crenate, but not at all divided; their surface minutely downy. Stem much branched; smooth below; downy above; bearing several fingered, veiny, smooth, sessile leaves; the lower ones largest, many-lobed, and jagged; the upper with only three lanceolate, entire lobes. Flowers rather small, deep yellow. Calyx hairy towards the base. Fruit ovate. Seeds hairy, roundish, slightly compressed, each with a strongly revolute beak.

22. *R. auricomus*. Wood Crowfoot, or Goldilocks. Linn. Sp. Pl. 775. Willd. n. 17. Ait. n. 13. Pursh n. 9. Fl. Brit. n. 5. Engl. Bot. t. 624. Curt. Lond. fasc. 2. t. 41. Fl. Dan. t. 665. Ger. Em. 954. (*R. prima species sylvestris*; Fuch. Hist. 156. Dalech. Hist. v. 1. 1029.)—Radical leaves kidney-shaped, deeply three-cleft, crenate; stem-leaves divided to the base into linear segments. Stem many-flowered. Calyx coloured.—Native of woods and shady places, throughout Europe; also in Pennsylvania; flowering in April and May. Root fibrous, perennal. Herb of a pale pleasant green, and destitute of the acrimony usual in this genus. Stems a foot high, erect, branched, scarcely downy, except near the top. Leaves generally a little downy; the radical ones on long stalks, deeply divided into three or five, wedge-shaped, crenate, or cut lobes; the rest in many linear, entire, or partially cut, spreading divisions. Flowers terminal, erect, solitary at the top of each branch, of a bright golden hue. Calyx pale yellow, hairy, scarcely at all reflexed. Nectary a naked pore in each petal, not closed by any scale. In cold backward seasons the petals are sometimes wanting, or rather identified with the calyx, which is then dilated, and more coloured than usual.

23. *R. abortivus*. Small-flowered Virginian Crowfoot. Linn. Sp. Pl. 776. Willd. n. 18. Ait. u. 14. Pursh n. 6.—Radical leaves heart-shaped, undivided, crenate; lower stem-leaves pedate; upper in three deep linear segments. Calyx reflexed, coloured. Petals obsolete.—In wet places, by the sides of ponds and ditches, from New York to Carolina, flowering in July and August. Pursh. In ponds at Buenos Ayres. Commerf. This species appears to have been cultivated in Chelsea garden 100 years ago, but it has, long since, disappeared, nor has any author given a figure of the plant. Its habit is most like *sceleratus*, n. 26. Root perennial, of many long fibres. Herb smooth. Stem from six to eighteen inches high, branched, leafy. Radical leaves like those of a violet, not an inch long, crenate, smooth; their stalks two inches, or more, in length: lower stem-leaves ternate, their lateral leaflets deeply divided, all cut or crenate: uppermost leaves nearly sessile, in three deep, lanceolate, entire divisions. Flowers small; yellow according to Pursh, but Commerf. in his MSS. calls them flesh-coloured; each stands on a simple solitary stalk, half an inch or an inch long, either from the forks of the branches, or at their summits. The calyx is reflexed, large, membranous and coloured. We find scarcely any certain traces of

petals, but the plant may be variable in these parts, like *auricomus*. Stamens few. Germen large, globose.—Linnæus took his specific character, *caule subtrifloro*, from specimens not fully grown; yet he had an authentic one by him, with above thirty flowers. In Commerf. the upper leaves are more stalked than usual.

24. *R. nitidus*. Varnished American Crowfoot. Walt. Carol. 159. Lamarck n. 68. Pursh n. 7.—“Very smooth. Stems hollow. Radical leaves roundish-kidney-shaped, bluntly crenate; stem-leaves sessile, digitate; their leaflets cut, with blunt segments. Seeds nearly globose, very smooth.”—In inundated grounds, from New York to Carolina, flowering in July and August.—Root perennial. Flowers small. Petals white. This and the foregoing one are probably only varieties. Pursh.

25. *R. trilobus*. Three-lobed Barbary Crowfoot. Del font. Atlant. v. 1. 437. t. 113. Willd. n. 19.—Stem erect, much branched. Leaves smooth, deeply three-lobed, cut; uppermost linear, obtuse, undivided. Flower-stalks striated. Seeds compressed, tuberculated.—Gathered by Desfontaines, in moist fields, near Mayane, in Barbary. He describes it as akin to *R. parviflorus*, except in its upright growth, and smooth, deeply three-lobed leaves. The lowest leaf of all is undivided and crenate. Flowers very small, yellow, situated as in the two last. Seeds in a round head, small, compressed, orbicular with a point, covered with tubercles on both sides. To us this species seems, by its seeds, allied to *parvulus* of Linnæus, which is a variety of *hirsutus*, hereafter described.

26. *R. sceleratus*. Celery-leaved Water Crowfoot. Linn. Sp. Pl. 776. Willd. n. 20. Ait. n. 15. Pursh n. 8. Fl. Brit. n. 6. Engl. Bot. t. 681. Curt. Lond. fasc. 2. t. 42. Fl. Dan. t. 571. (*R. palustris rotundifolius*; Ger. Em. 962.)—Stem erect, much branched. Lower leaves palmate, smooth; upper ones fingered. Fruit oblong. Seeds very numerous, minute.—Found about ditches and in watery places by road sides, in most parts of Europe and North America, flowering in summer. Root annual. Herb various in size and luxuriance, of a pale shining green, juicy, very smooth, except occasional hairiness on the flower-stalks. Stem round, thick and hollow. Lower leaves larger, broader, less divided, and more stalked, than the upper; the floral ones mostly lanceolate, simple, and entire. Flowers numerous, small, yellow. Calyx deflexed, shaggy. Nectary somewhat tubular. Stamens few. Seeds very small, but excessively numerous, making a dense, oblong, obtusely rounded head. This is one of the most acrid of its tribe, raising blisters and dangerous sores in the skin.

27. *R. aconitifolius*. Aconite-leaved White Crowfoot. Linn. Sp. Pl. 776. Willd. n. 21. Ait. n. 16. Curt. Mag. t. 204. (*R. montanus quartus*; also *R. pleno flore albo*; Clus. Hist. v. 1. 236. *R. aconiti folio*; Ger. Em. 954. *R. albus multiflorus*; ib. 957. *R. albus, flore denso*; Bauh. Hist. v. 3. 844, not 860.)—Leaves veiny, smooth, in five deep, pointed, toothed lobes; the middle one three-cleft: floral leaves sessile, fingered, lanceolate, cut. Stem branched, many-flowered.—Native of the alps of Switzerland, France, Austria, &c.; a hardy and long-established perennial in our gardens, flowering in May and June; generally in a double state, as figured by Curtis. He remarks that it requires moisture, shade, and a pure air. The stem is one and a half or two feet high, partly purplish, smooth, with spreading branches. Leaves dark green, with a glaucous hue beneath; the radical ones on long stalks; the rest nearly sessile; all composed of more or less distinctly separate, often stalked, leaflets, strongly veined and coarsely toothed; the uppermost smaller, more simple, quite sessile.

Flowers

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Flowers white, three-quarters of an inch in diameter, not very ornamental in their single wild state, but much admired when double, and formerly called Fair Maids of France. Their pearly whiteness is enhanced by the violet *calyx*.

28. *R. platanifolius*. Plane-tree-leaved White Crowfoot. Linn. Mant. 79. Willd. n. 22. Ait. n. 17. Fl. Dan. t. 111. (*R. albus*, flore simplici; Lob. Ic. 668. *R. alpinus albus*; Ger. Em. 951.)—Leaves veiny, smooth, deeply palmate, five-lobed, cut and toothed; the middle ones three-cleft: floral leaves sessile, fingered, linear-awlshaped, entire. Stem branched, many-flowered.—Native of the Alps of Germany, Norway, Switzerland, Italy, and of the Pyrenees, in shady places. Said to have been introduced into the English gardens in 1769, by Messrs. Kennedy and Lee. This is very distinct from the last, with which Linnæus originally confounded it. The *leaves* are larger, not divided quite to the base, though their lobes are more cut and jagged: the floral ones are remarkably long, slender, and entire. *Flowers* twice as large, and rather more abundant. The radical *leaves* of both have occasionally seven or nine lobes, instead of five.

29. *R. spicatus*. Spike-fruited Crowfoot. Desfont. Atlant. v. 1. 438. t. 115. Willd. n. 23.—Leaves radical, five-lobed, toothed. Stem nearly simple, hairy. Fruit cylindrical, thrice as long as the *calyx*.—Gathered by Desfontaines in marshes at Algiers. *Root* perennial, of numerous, oblong, fleshy, tapering knobs. *Stem* solitary, erect, a span high, hairy, simple, except at the top, where it divides into two or three simple single-flowered stalks; sometimes accompanied by a few *bractæas*, in three or four deep linear segments; sometimes naked. *Leaves* all radical, on hairy stalks, heart-shaped, rounded, five-lobed, strongly toothed, villous, about an inch and a half broad. *Calyx* of five ovate-oblong, coloured, hairy, spreading leaves. *Petals* five, obovate, yellow, the size of *R. acris*. *Fruit* cylindrical, slender, an inch and a half or two inches long. *Seeds* very numerous, ovate, compressed, bordered each with a hooked, prominent beak.

30. *R. paludosus*. Marsh Crowfoot. Poir. Voy. en Barb. v. 2. 184. Lamarck n. 22. Desfont. Atlant. v. 1. 439.—“Downy. Lower leaves in three deep, many-cleft, fan-shaped segments; upper simple, linear, entire. Stem branched, many-flowered. *Calyx* erect.”—Gathered by Poir. in the borders of extensive marshes, near la Calle, and in some other parts of Barbary. *Root* fibrous, densely fasciculated. *Herb* downy, with short, close-pressed hairs. *Stems* several, eight or ten inches high, with spreading leafy branches, bearing abundance of widely-spreading, deep-yellow *flowers*, the size of the foregoing, on slender stalks of various lengths. Radical *leaves* stalked; the earliest ones ovate, undivided, deeply toothed; the rest almost pinnate, with three long, narrow, deeply cut, fan-shaped segments; those on the lower part of the stem less compound: the uppermost linear, undivided, acute, entire. *Fruit* oval, or almost elliptical, obtuse. *Seeds* oblong, smooth, compressed, scarcely pointed.

31. *R. illyricus*. Illyrian Silky Crowfoot. Linn. Sp. Pl. 776. Willd. n. 24. Ait. n. 18. Jacq. Austr. t. 222. Ger. Dod. Pempt. 428. Em. 953. (*R. grumosa radice quartus*; Clus. Hist. v. 1. 240.)—Leaves shaggy with silky hairs, linear-lanceolate, ternate, entire. *Calyx* silky, reflexed. Stem branched. Flower-stalks woolly.—Native of Hungary, France, Italy, Austria, Thrace, and of the Swedish isle of Oeland; cultivated here in Gerarde's time. Clusius received his specimens, from a physician of Ferrara, with the name of *R. illyricus*, which has been retained, absurdly enough, for a plant found in so many different countries,

and for which so many expressive appellations might easily have been contrived. The *root* is perennial, composed of numerous, small, round granulations. Whole herb more or less clothed with snow-white, silky, or partly cottony, down. *Stem* a foot high, or more, somewhat branched, bearing several bright lemon-coloured *flowers*, nearly the size of *R. Lingua*, their *calyx-leaves* ovate, reflexed, externally silky. *Leaves* all linear-lanceolate, entire, seldom divided; the radical ones on long stalks, ternate or pinnate; those about the middle of the stem ternate, almost sessile; upper ones simple: the usual length of each leaf or leaflet is two or three inches.—Dodonæus takes this for the second *Βαλζαχιον*, or *Ranunculus*, of Dioscorides, with whose description it in some measure accords. That species is said to be extremely acrid. Hence Dodonæus, who is copied by Gerarde, supposes our plant may be the *Gelotophyllis* of Pliny, which caused those who took it to dye laughing. But this opinion depends on too many conjectures to deserve attention; even if any benefit could accrue from ascertaining the point. We must observe however that Dr. Sibthorp thought the above *Ranunculus* of Dioscorides to be our *lanuginosus*, which is a common Greek plant, and answers better to his description.

32. *R. flabellatus*. Fan-leaved Crowfoot. Desfont. Atlant. v. 1. 438. t. 114. Willd. n. 25. Sm. Fl. Græc. Sibth. t. 520, unpublished. (*R. alter saxatilis, asphodeli radice*; Column. Echpr. 312. t. 313.)—Radical leaves undivided or twice ternate, toothed or deeply cut, stalked; upper ones ternate or simple. Stem hairy, simple below, few-flowered. Fruit elliptical.—Found by Desfontaines, near Algiers, on moist uncultivated hills, flowering in winter: by Sibthorp on the northern mountains of Greece. *Root* perennial, of many oblong, tapering, clustered fibres, rather than knobs. *Stem* a span high, hairy, somewhat divided above, and bearing two or three yellow *flowers*, the size of our common *R. bulbosus*, accompanied by deeply two or three-cleft *bractæas*. *Leaves* chiefly radical, on longish stalks; several of the earliest undivided, fan-shaped, strongly toothed; the rest deeply three-cleft, and subdivided.

33. *R. asiaticus*. Persian Crowfoot, or common Garden Ranunculus. Linn. Sp. Pl. 777. Willd. n. 26. Ait. n. 19. Mill. Ic. t. 216. Sm. Fl. Græc. Sibth. t. 518, unpublished. (*R. asiaticus, grumosa radice*; Clus. Hist. v. 1. 240—243. *Ranunculi varii*; Ger. Em. 958—960. *Βαλζαχιον*; Diosc. book 2. chap. 206.)—Leaves once or twice ternate; leaflets three-cleft, cut. Stem hairy, branched. Petals thrice as long as the *calyx*. Fruit cylindrical.—Found by Dr. Sibthorp wild in various parts of Asia Minor, but most plentifully in the isle of Cyprus, where it still retains one of its ancient names, mentioned by Dioscorides, *αγριο-σίλινον*, or Wild Parsley. In the gardens of Europe it has been cultivated, ever since the latter part of the sixteenth century, under the form of innumerable varieties, chiefly double, of every variegated hue. In a wild and single state the large and splendid *petals* are of a most vivid crimson, occasionally varying to yellow. The *root* is perennial, of numerous, brown, fleshy, tapering knobs. *Stem* twelve or fifteen inches high, erect, round, downy, hoary, leafy, branched from the middle or lower part, and bearing from three to five large long-stalked *flowers*, whose *calyx* is brown, hairy, and reflexed, but one-third the length of the broad, obovate, concave *petals*. *Leaves* rather hairy, mostly stalked, variously three-cleft and notched, more or less compound; the floral ones, as usual, narrower and most simple. *Fruit* cylindrical. *Seeds* oblong, with recurved points.

34. *R. japonicus*. Japan Crowfoot or Ranunculus. Thunb. Tr. of Linn. Soc. v. 2. 337. Willd. n. 27. (*R. asiaticus*;

asiaticus; Thunb. Jap. 241.)—"Leaves deeply three-cleft, cut and toothed, hairy as well as the stem."—Common in ditches about Nagasaki, Jedo, and elsewhere in Japan, flowering from February to May. It is hairy in every part, except the *corolla*. The radical leaves are rounded; the uppermost divided into lanceolate segments; all three-cleft, their segments cut, toothed, acute, hairy on both sides. *Footstalks* from an inch to a foot in length. *Stems* striated, scarcely leafy, zigzag, branching into flower-stalks at the top. *Thunberg*. The above character and description are not sufficient to distinguish this species from the last, with which Thunberg originally confounded it. Something is necessary to be known respecting the *calyx*, and its relative proportion to the *petals*, as well as the form of the *fruit* and *seeds*.

35. *R. rutae-folius*. Rue-leaved Crowfoot. Linn. Sp. Pl. 777. Willd. n. 28. Ait. n. 20. Jacq. Coll. v. 1. 186. t. 6, 7. Allion. Pedem. v. 2. 49. t. 67. f. 1. (*R. præcox* rutaceo folio; Clus. Hist. v. 1. 232. Ger. Em. 965. Ranuncolo alpino, con foglia di Coriandro; Pon. Bald. 197.)—Leaves pinnate, ternate, many-cleft, glaucous, smooth; their segments elliptic-oblong. Stem nearly simple. Petals numerous. Calyx smooth. Seeds ovate, with straight points.—Native of the loftiest alps of Switzerland, Dauphiny, Austria, and the north of Italy, flowering early in July. The *root* is tuberos, with long, simple, stout fibres, perennial. *Herb* glaucous and smooth. *Stem* from two to five inches high, mostly simple and single-flowered, sometimes bearing two, rarely three, flowers. *Leaves* stalked, elegantly decompounded; their leaflets wedge-shaped, many-cleft; the ultimate segments oblong, slightly elliptical, bluntish. *Flowers* of a brilliant white, at first tinged with red, on long stalks. *Calyx* purplish, five-leaved, smooth. *Petals* eight or ten, very erroneously represented in the figure of Clusius and Gerarde, so as to look like a syngeneis flower. *Seeds* few, large, ovate, pitted, pointed, straight, spreading every way, stalked, in a round head.

36. *R. glacialis*. Alpine Hairy-cupped Crowfoot. Linn. Sp. Pl. 777. Fl. Lapp. ed. 196. t. 3. f. 1. Willd. n. 29. Ait. n. 21. Fl. Dan. t. 19. (*R. montanus* purpureus, calyce villoso, Felicis Platerii; Bauh. Hist. v. 3. b. 846. Scheuchz. Alp. v. 1. 399, and 139. t. 20. f. 1.)—Leaves ternate, three-cleft, cut; their segments elliptical. Stem nearly simple. Calyx very hairy.—Native of the highest alps of Lapland, Switzerland, Dauphiny, Germany, &c. in the neighbourhood of ice and snow, flowering in June and July. *Root* perennial, with very long strong fibres. *Stem* from three to six inches high; simple and naked in its lower part; leafy near the top, bearing one or two, very rarely three, flowers, on long, smooth stalks. *Leaves* green, scarcely hairy, rather fleshy; the radical ones more or less compound, on long stalks; their segments broader, more elliptical, and blunter than in the former. *Flowers* large and handsome, of five broad, roundish, white petals, rose-coloured or purple underneath; the *calyx* purplish-brown, singularly rough, with shining tawny hairs. When we contemplate the great diversity of subdivision in the foliage of this species, we are disposed to believe our *frigidus*, n. 18, may possibly be a mere variety. Their *flowers* precisely agree, as well as their general habit.

37. *R. Seguieri*. Sharp-leaved Alpine Crowfoot. Villars Dauph. v. 3. 737. t. 49. Willd. n. 30. (*R. Columnæ*; Allion. Pedem. v. 2. 50. t. 67. f. 3, 4. Wulf. in Jacq. Coll. v. 4. 345. *R. alpinus* apii folio, flore albo magno; Pont. Comp. 117. Seguier Veron. v. 1. 490. t. 12. f. 2, 3.)—Leaves ternate; segments wedge-shaped, subdivided, decurrent, acute. Stem branched, about three-flowered.

Calyx smooth.—Native of mount Baldus, where it was first found by Pontedera; as well as of the mountains of Dauphiny, Piedmont, and Carniola; in stony situations. This resembles some of the most luxuriant varieties of *glacialis*, but differs in the acute and decurrent segments of its leaves, as well as its smooth pale *calyx*; for Villars is incorrect in describing that part "externally downy." It is quite smooth, in his own and Allioni's specimens; the hairiness being confined to the top of the *flower-stalk*, where it is very dense and conspicuous; while the same part in *glacialis* is smooth, up to the base of the hairy *calyx*. The *petals*, and even the *nectary*, are white. Villars is surely right in removing the synonym of *Columna*, cited by Allioni, which we refer, with hardly any scruple, to *flabellatus*, n. 32, a very different plant.

38. *R. nivalis*. Palmate Alpine Crowfoot. Linn. Sp. Pl. 778. Fl. Lapp. ed. 2. 195. t. 3. f. 2. Willd. n. 31. (Excluding the variety.)—Leaves palmate, five-lobed, spreading, entire; those of the stem sessile. Stem single-flowered, smooth. Calyx hairy, half the length of the petals.—Found by Linnæus in Lapland, by the alpine rivulets on the snowy mountains of that country. Martens had previously gathered it at Spitzbergen. The *root* is fibrous, and slender. *Stem* simple, erect or ascending, smooth, leafy, about six inches high. *Radical leaves* two or three, on long slender stalks, heart-shaped at the base, rather deeply palmate, in five broad, divaricated, obovate, entire lobes, very and quite smooth: *stem-leaves* one or two, sessile, with five deeper, longer, more lanceolate lobes; the uppermost only three-lobed, or occasionally quite undivided. *Flower* solitary, on a long, terminal, hairy stalk. *Calyx* of five ovate yellowish leaves, rough with blackish hairs. *Petals* yellow, obovate, twice the length of the *calyx*.

39. *R. pygmaeus*. Dwarf Small-flowered Alpine Crowfoot. Pursh n. 10. (*R. nivalis* pygmaeus; Linn. Fl. Lapp. ed. 2. 196. t. 3. f. 3. *R. lapponicus*; Fl. Dan. t. 144.)—Leaves palmate, somewhat pedate, five-lobed, spreading entire; the upper ones almost sessile. Stem single-flowered. Calyx nearly smooth, rather longer than the petals.—Native of Lapland and Labrador. Perennial, flowering in May and June. Much smaller than the foregoing. Middle lobe of the *radical leaves* very deeply separated. *Stem-leaves* less perfectly sessile, and with narrower segments, than in *nivalis*. *Flower* not a quarter the size of that species; its petals yellow, roundish, scarcely so long as the *calyx*, which is likewise small, and very slightly hairy.

40. *R. montanus*. Yellow Mountain Crowfoot. Willd. n. 32. Ait. n. 22. (*R. nivalis*; Jacq. Austr. t. 325, 326. Sibth. in Prodr. Fl. Græc. n. 1272? Villars Dauph. v. 3. 742. Crantz Austr. fasc. 2. 92. t. 4. f. 3, 4. R. n. 1168; Hall. Hist. v. 2. 71, excluding the references to Linnæus. *R. minimus alpinus luteus*; Bauh. Hist. v. 3. 845, two upper figures.)—Leaves five-lobed, rounded, cut; those of the stem sessile, with deep, lanceolate, entire segments. Stem single-flowered, rough with erect hairs. Calyx hairy.—Very abundant on the alps of Switzerland, Dauphiny, and Germany; not of Lapland. It was one of those many alpine plants, introduced into the English gardens in 1775, by a person sent on purpose to collect them, at the expence of Dr. Fothergill and Dr. Pitcairn. This species has been confounded with the Linnæan *nivalis*, by all writers previous to Willdenow; yet they are truly distinct. The *montanus* has remarkably long, subdivided, tuberos roots, with very long strong fibres. *Stem* hairy throughout, the hairs erect; sometimes quite leafless. Lobes of the radical leaves un-

equally

equally cut and toothed, not entire. *Calyx-leaves* narrower, and less hairy. *Petals* larger, and of a deeper yellow. This is the *nivalis* of most botanists, few having seen the true Linnæan Lapland plant. The variety of *montanus* with a leafless *stem*, figured in Jacquin's t. 326, at the right hand, was taken for a new species, and called *acaulis*, by Favrod and Reynier, as appears by their dried specimens.

41. *R. Gouani*. Gouan's Pyrenean Crowfoot. Willd. n. 33. (*R. pyrenæus*; Gouan Illustr. 33. t. 17. f. 1, 2.)—Leaves five-lobed, rounded, cut; those of the stem sessile, deeply palmate; the uppermost with acute, entire lobes. Stem single-flowered, rough with deflexed hairs. Calyx hairy.—Gathered by Gouan on the Pyrenees, where it flowers soon after the melting of the snow. We have a specimen from the late M. Broussonet. This is a larger plant than the preceding, especially in its *flower*, and differs, as Willdenow remarks, in having the *stem-leaf* toothed or cut; but that character applies only to the lower one. The upper *stem-leaves*, if there be more than one, consist of entire, acute lobes. The most decisive mark of distinction appears to us in the hairs of the *stem*, below the leaves, which in Gouan's plant are either widely extended or bent downwards; in the *montanus* the hairs of every part of the *stem* are erect, or close-pressed. To this no person has hitherto adverted.

42. *R. alpestris*. Alpine White Crowfoot. Linn. Sp. Pl. 778. Willd. n. 34. Ait. n. 23. Sm. Tr. of Linn. Soc. v. 10. 343. Engl. Bot. t. 2390. Jacq. Austr. t. 110. (*R. n.* 1167; Hall. Hist. v. 2. 71. *R. montani* species prima et secunda; Clus. Hist. v. 1. 234. *R. montanus*, flore minore, & majore; Ger. Em. 964. *R. minimus alpinus albus*; Bauh. Hist. v. 3. 845, two lower figures.)—Leaves very smooth; radical ones somewhat heart-shaped, obtuse, in three deep, lobed segments; stem-leaf lanceolate, entire. Stem mostly single-flowered.—Native of the highest alps of Austria and Switzerland, and of the mountain of Clova, in Angusshire, Scotland, in which last place it was discovered by the late Mr. George Don, by the sides of little rills, flowering, though sparingly, in the spring of 1809. The roots are perennial, with long fibres. Whole herb very smooth, and rather glaucous. Stem erect, from one to four inches high, almost always simple and single-flowered, naked, except one or two simple, linear-lanceolate, obtuse, entire leaves, apparently of the nature of *bracteas*. Radical leaves several, stalked, in three deep, subdivided, acute lobes. *Calyx-leaves* oval, smooth, edged with white. *Petals* of a pure and brilliant white. Haller says this is one of the most acrid of its tribe, blistering the skin; and yet the alpine hunters chew it, by way of refreshment.

43. *R. lapponicus*. Long-stalked Lapland Crowfoot. Linn. Sp. Pl. 778. Fl. Lapp. ed. 2. 194. t. 3. f. 4. Lapland Tour, v. 1. 156, 252.)—Leaves smooth, in three very deep, dilated, bluntly notched lobes. Flower-stalks elongated, naked, single-flowered. Petals the length of the smooth calyx.—This rare species, not known out of the limits of Lapland, was discovered by Linnæus in two or three different places, near the river Juchtan, flowering in June. Professor Swartz also gathered it, many years after, near Luloa. It grows in watery situations, and is very different from all others of this genus. The aspect of the plant, at first sight, recalls the idea of *Adoxa Moschatellina*. The root is long, thread-shaped, and creeping, throwing up here and there, from its joints, a little, short, simple, solitary, smooth stem, sometimes an inch or two high, sometimes scarcely distinguishable. Leaves one from the base, and another from the top, of the stem, on slender, weak foot-stalks, two or three inches in length; each leaf an inch or

an inch and half wide, smooth, veiny, rather fleshy, somewhat kidney-shaped, in three very deep, almost distinct, broad wedge-shaped lobes, having a few broad and rounded, blunt notches, each tipped with a minute glandular point. Flower-stalks from three to five or six inches high, terminating the stem, solitary, simple, naked, smooth, each bearing a small yellow flower, scarcely half an inch in diameter. Calyx of three elliptical, concave, smooth, pale, reflexed leaves. Petals five or six, obovate, ribbed, about the length of the calyx; their nectary closed by a scale. Stamens from nine to twelve. Pistils from six to twelve. Seeds in a round head, ovate, smooth, with strongly recurved points.

44. *R. hyperboreus*. Arctic Crowfoot. Retz. Scand. ed. 2. 131. Willd. n. 36. "Rottb. in Copenh. Transf. v. 10. 458. t. 4. f. 16." (*R. Fl. Dan.* t. 331, excluding the synonym of Ammann, which belongs to *salsuginosus*, n. 15. *R. n.* 50; Gmel. Sib. v. 4. 204. t. 83, b, excluding the Linnæan synonyms.)—Leaves smooth, in three deep divaricated lobes; the lateral ones cloven. Stem creeping. Flower-stalks the length of the leaves. Petals scarcely longer than the smooth calyx.—Native of Iceland, Greenland, Norway, and Siberia, in watery places. Gmelin and Linnæus confounded this with *hederaceus* hereafter mentioned; Gunner mistook it for *salsuginosus*, which he called *R. Ammanni*, Fl. Norv. n. 826. From both, as well as from *lapponicus*, it is very distinct. The stems are long and creeping, or floating, throwing out from each joint, several simple, very long, fibrous radicles, with a stalked leaf, not a quarter the size of *lapponicus*, whose lobes are by no means toothed or crenate, the lateral ones only being simply cloven. The flowers are small, pale yellow, solitary, each on a lateral, but not axillary, stalk, whose length is about equal to the adjoining leaf with its foot-stalk. Calyx-leaves only three or four, smooth, coloured. Petals about the same number, and scarcely longer, obovate. Seeds ovate, gibbous, with a hooked, but very short, beak.

45. *R. monspeliacus*. Montpellier Crowfoot. Linn. Sp. Pl. 778. Willd. n. 37. (*R. saxatilis*, magno flore; Bauh. Prodr. 96. Sauv. Monsp. 181.)—"Leaves in three deep crenate segments. Stem simple, villous, nearly naked, single-flowered."—Native of rocky places about Montpellier, according to Bauhin, who thus describes his plant. "Root composed of long capillary fibres. Leaves from the root several; on long, somewhat woolly, stalks, each leaf hardly so broad as the nail, in three small segments, which are again divided into two or three acute ones. The stem is about three inches high, slender, woolly, bearing one large flower, of a brilliant golden yellow, composed of five petals, with many reddish stamens." We know no authentic specimen nor figure of this plant. Linnæus has marked it as never seen by him; but a specimen sent him by Gouan, from the Pyrenees, marked *R. alpinus humilis*, magno flore, which we have been disposed therefore to consider as *R. Gouani*, n. 41, answers very well to Bauhin's description, and it is not impossible that these supposed two species are one and the same. Yet Poiret, who professes to have gathered *R. monspeliacus* at Montpellier, and in Barbary, speaks of them as distinct, though, it must be confessed, his description is hardly sufficient to establish the point in dispute.

46. *R. pensylvanicus*. Penſylvanian Crowfoot. Linn. Suppl. 272. Willd. n. 38. Ait. n. 24. Pursh n. 11. (*R. canadensis*; Jacq. Ic. Rar. t. 105. Misc. v. 2. 343.)—Stem erect, hairy, branched. Leaves ternate; leaflets stalked, deeply three-cleft, jagged, toothed; hairy beneath. Calyx reflexed, rather longer than the round petals. Fruit cylindrical.

cylindrical. Seeds compressed, with straight beaks.—Native of low meadows, from Canada to Pennsylvania, but rare, flowering in July and August. This species was sent by professor Thunberg, in 1785, to Kew garden, from whence we procured a specimen the same year. Mr. Aiton makes it biennial; Jacquin and Pursh perennial. The stem, like the footstalks, is very hairy. Whole herb of a light green, two feet or more in height, branched, many-flowered. Leaflets one and a half or two inches long, strongly veined, with spreading segments. Flower-stalks terminal, longish, furrowed, rough with close-pressed hairs. Flowers small, their little, round, yellow petals not so long as the calyx, which is smooth and bent downward. Seeds in a cylindrical head, numerous, ovate, gibbous, compressed, smooth, very minutely dotted, each tipped with a short, sharp, erect, or slightly inflexed, beak. Receptacle hairy. Mr. Pursh's description does not, in every circumstance, answer to the Linnæan plant; for the flowers are not near so big as *R. acris*, nor are their stalks round.

47. *R. ternatus*. Ternate-leaved Japanese Crowfoot. Thunb. Jap. 241. Willd. n. 39.—"Calyx reflexed. Leaves all ternate; leaflets three-cleft. Stem many-flowered."—Native of the Japanese island of Nipon, flowering in May. Nothing more is known of this species, concerning whose peculiar characters, or affinities, we can form no precise opinion.

48. *R. biternatus*. Twice-ternate Magellanic Crowfoot.—Leaves smooth, twice ternate, cut; segments ovate, acute. Stem creeping. Stalks single-flowered, the length of the leaves. Petals obovate, the length of the smooth calyx.—Gathered by Commerçon, in the straits of Magellan. No author appears to have taken up this species, of which a specimen, from Commerçon's herbarium, was given by Thouin to the younger Linnæus. The whole plant is smooth. The leaves bear a considerable resemblance to those of *R. Segueri*, but are rather smaller, and distinctly twice ternate. The habit of the plant more accords with *lapponicus* and *hyperboreus*, however unlike at first sight. The stem is thread-shaped and creeping, sending forth, from every joint, a few fibrous radicles, a pair of upright, stalked leaves, two or three inches in height, and one flower, whose simple, naked stalk is about as tall as the leaves. This flower appears to be extremely like that of *lapponicus*, though scarcely more than half so large. The dried petals have the same opaque whiteness as is observable in that species, and others, on their upper surface, and are probably yellow when fresh.

49. *R. peduncularis*. Long-stalked Magellanic Crowfoot.—Leaves ternate, deeply cut, somewhat hairy. Stems hairy, taller than the leaves, two-flowered. Calyx reflexed, nearly smooth. Seeds globose, smooth, with recurved, hooked beaks.—Gathered by Commerçon in the straits of Magellan, with the preceding. This has a general likeness to several common European kinds, which we shall next describe, but is essentially distinct. The radical leaves are several, on hairy stalks, four inches long, their circumscription roundish, measuring an inch, or inch and half, across; the leaflets almost always quite distinct, with short partial stalks, their form wedge-like, or fan-shaped, more or less deeply cut, seldom regularly three-cleft. Stems several, erect, striated, rough, with spreading hairs; simple and naked to the height of four or six inches, then dividing into two upright, hairy, simple flower-stalks, greatly elongated, (from one to seven or eight inches), after flowering, and accompanied at their base by a solitary, stalked, deeply divided, palmate or fingered, leaf, an inch long. The flowers are much like those of *bulbosus*, or *acris*. Calyx-leaves ovate, concave, reflexed, bearing a few external hairs.

Petals yellow, wedge-shaped, striated, nearly twice as long as the calyx. Fruit globose. Seeds globose, tumid, keeled, even and smooth; their beaks rather spreading, hooked at the tip.

50. *R. bulbosus*. Bulbous Crowfoot, or Butter-cups. Linn. Sp. Pl. 778. Willd. n. 40. Ait. n. 25. Fl. Brit. n. 7. Engl. Bot. t. 515. Pursh n. 12. Curt. Lond. fasc. 1. t. 38. Mart. Rust. t. 28. Ger. Em. 953. Lob. Ic. 666.—Leaves hairy, ternate, three-cleft, cut. Stem many-flowered. Calyx reflexed. Seeds compressed, smooth. Root bulbous.—Very common in Europe, as well as North America, in meadows and pastures, flowering throughout the summer. The root is a round, solid, perennial bulb, about an inch in diameter, increasing by offsets from the top, and sending out from its base many long stout fibres. Stems several, erect, a foot high, branched, leafy, round, hairy, many-flowered, destitute of trailing shoots or runners. Leaves stalked, variously cut, more or less hairy. Flowers terminal, solitary, on angular furrowed stalks, rough with erect, bristly hairs. Calyx hairy, bent back to the stalk. Petals nearly equal in size to *R. Lingua*, of a deep shining yellow. Nectary covered by a notched scale. Fruit globose. Seeds orbicular, greatly compressed, bordered, smooth, and even, tipped with a short blunt beak.—This is one of the most acrid, and even caustic, species. Villars says the root may be used as a blister, instead of cantharides, but not so safely. It is most active in the spring, and must not then be left on the skin more than four or six hours, for fear of leaving a dangerous spreading sore.

51. *R. hirsutus*. Pale Hairy Crowfoot. Curt. Lond. fasc. 2. t. 40. Fl. Brit. n. 8. Engl. Bot. t. 1504. Ait. n. 26. (R. Philonotis; Ehrh. Beitr. fasc. 2. 145. Herb. 116. Willd. n. 41. Lamarck Dict. n. 48. Pursh n. 13. R. fardous; Crantz Austr. fasc. 2. 84. Lamarck Dict. n. 47. R. pallidior; Villars Dauph. v. 2. 751. R. bulbosus β ; Hudf. Angl. 241. R. rectus foliis pallidioribus, hirsutis; Bauh. Hist. v. 3. p. 2. 417. R. secundus; Matth. Valgr. v. 1. 559. R. palustris, apii folio lanuginosus; Bauh. Pin. 180. Morif. sect. 4. t. 29. f. 27 and 28.) — β . R. parvulus; Linn. Mant. 79. Fl. Brit. n. 11. Willd. n. 50. Ait. n. 31. Lamarck Dict. n. 73. R. agrarius; ib. n. 46? R. minimus faxatilis hirsutus; Bauh. Prodr. 96. R. minimus apulus; Column. Ecphr. 314. t. 316. f. 1.—Leaves ternate, notched. Stem erect, branched. Calyx reflexed. Seeds orbicular, compressed with a short ascending beak, bordered; tuberculated at the sides.—Native of moist ground, in various parts of Europe, from Britain to Greece, flowering from June to October. The root is fibrous and annual. Stem erect, generally much branched, leafy, spreading, many-flowered, striated, clothed with soft, widely spreading hairs; in variety β smaller, smoother and weaker, sometimes, in a very starved state, bearing but one or two flowers. Leaves on longish, more or less hairy, footstalks, pale green, hairy, ternate, varying much in size; their leaflets wedge-shaped, sometimes deeply three-lobed, sometimes only bluntly notched; upper ones narrower and more simple, nearly sessile. Stipulas membranous, hairy, somewhat dilated, attached to the base of the footstalks. Flowers on long, terminal, furrowed, hairy stalks, solitary, smaller than in *bulbosus*. Calyx hairy, reflexed. Petals roundish; of a bright shining yellow above; paler and opaque beneath. Nectary closed by an abrupt scale. Fruit globose. Seeds lenticular, compressed, brown, with a triple-ribbed greenish border; their beaks short, ascending, very obscurely hooked; their sides studded with minute sharp tubercles, especially towards the margin, where they are often circularly arranged, as Poiret (or

Lamarck) describes them in his *R. agrarius*, cited above.—This species has been very little understood. It is remarkable that any botanist should confound it with *bulbosus*, or with *sceleratus*, and that Mr. Curtis, in labouring to distinguish it, did not advert to the decisive character of the tuberculated seeds, by which it approaches a very different tribe, hereafter described, consisting of *parviflorus*, *muricatus*, &c. Even Ehrhart has not noticed this circumstance. We are obliged to Mr. Edward Forster, F.L.S. for tracing out the identity of *R. parvulus* and *hirsutus*, and we cannot but prefer Curtis's original name for the species, rather than Ehrhart's pedantic one of later date. On the account of priority *jardous* perhaps ought to have been retained; but this name is founded on a very dubious opinion, that the plant of which we are speaking caused the Sardoniac laugh. Valerius Cordus, indeed, says it grows copiously in Sardinia, and it has certainly the appearance of Smallage, *Apium*; so far answering to the ancient history. But the account of Cordus seems taken from Dioscorides, whose "second *Ranunculus*" is more probably the Linnæan *lanuginosus*, a still more general plant of the south of Europe than that of which we are speaking. After all, the famous Sardinian herb, compared to Smallage, may be actually wild Smallage or Celery, *Apium graveolens*, which is sufficiently acrid and poisonous to warrant our supposition, though it becomes sweet and wholesome by culture. In this uncertainty it is surely best to call our plant *R. hirsutus*.

52. *R. palustris*. Oriental Marsh Crowfoot. Linn. MSS. (*R. orientalis palustris*, apii folio, caule subhirsuto; Tourn. Cor. 20.) Leaves hairy, in three or five deep segments, bluntly notched, with rounded dilated sinuses. Stem erect, branched, almost leafless. Calyx spreading. Seeds ovate, compressed, very smooth, with a short recurved beak.—Native of the Levant. An oriental specimen, with Tournefort's synonym, is preserved in the Linnæan herbarium, and named *palustris*, but we can find no mention of it elsewhere. This is certainly a most distinct species, though not taken up by any recent author. The root consists of many fleshy knobs, tapering into fibres, and resembling those of *R. asiaticus*, though not so thick. Stem two feet or more in height; hairy below; much branched, and almost leafless above; the branches ternate. Leaves chiefly radical, on long hairy stalks; their outline somewhat pentagonal; heart-shaped at the base; hairy on both sides, about two inches wide; their three principal lobes spreading, deeply separated by wide rounded sinuses, and notched unequally at the extremity with broad, rounded, abrupt teeth; the upper or floral leaves are small, short, linear, undivided. Flowers, as far as we can judge, yellow, not large. Calyx hairy, spreading widely, but scarcely reflexed. Seeds in a round head, brown, shining, quite smooth, compressed, most like those of *bulbosus*, but more ovate, and with a longer, more recurved, and somewhat hooked, beak. Their edge is green, simple, not triple-ribbed as in the last.

53. *R. polyrhizos*. Many-rooted Siberian Crowfoot. Willd. n. 42. Lamarck Dict. n. 38.—Radical leaves palmate, with wedge-shaped, three-toothed segments; stem-leaves sessile, fingered. Stems many-flowered. Root fasciculated. Calyx spreading. Seeds ovate, compressed, smooth, with a blunt beak.—Native of Siberia. Root fasciculated, perennial. Radical leaves like *R. sceleratus*, three-lobed; their lateral lobes two-lobed, wedge-shaped like the leaf itself, their segments bluntly three-toothed. Stems a finger's length, simple, erect or ascending, two or three from one root. Stem-leaves sessile, fingered, wedge-shaped at the base; their segments linear, bluntish, entire. Flower-stalks two,

three, or four, long, single-flowered, round, not furrowed, very finely downy like the stem. Calyx-leaves coloured, smooth, obtuse, spreading. Petals yellow, the size of *R. Flammula*. Fruit roundish. Seeds ovate, compressed, smooth, crowned with the permanent blunt stigma. Willdenow. By the above description this species appears related, in many points, to the last, though they can hardly be the same.

54. *R. repens*. Common Creeping Crowfoot. Linn. Sp. Pl. 779. Willd. n. 43. Ait. n. 27. Pursh n. 14. Fl. Brit. n. 9. Engl. Bot. t. 516. Curt. Lond. fasc. 4. t. 38. Mart. Rust. t. 29. (*R. pratensis*, etiamque *hortensis*; Ger. Em. 951.)—Leaves ternate, three-cleft, cut, hairy. Stems ascending. Runners creeping. Flower-stalks furrowed. Calyx hairy, spreading. Seeds ovate, compressed, even.—Very common in meadows, waste ground, church-yards, neglected gardens, and fields, throughout Europe. Mr. Pursh observed it in shady wet woods, particularly on the mountains, from Pennsylvania to Virginia. It flowers from June to August, and is perennial, being often a troublesome weed. Root fibrous. Besides the upright stems, which are of humble growth, leafy, branched, bearing several flowers, the root sends forth long trailing creeping shoots, whose joints produce leaves, and some shorter simpler stems. The whole herb is rough and hairy, of a dark green. Leaves stalked, ternate, more or less three-cleft, sharply cut or toothed; often marked with dark purple, or black, sometimes pale, spots; the uppermost linear-lanceolate and entire. Calyx hairy, spreading, not reflexed. Petals deep yellow, generally emarginate. Nectary covered by a heart-shaped scale. Fruit globose. Seeds ovate, compressed, smooth at the sides, often hairy at the edge, their beak short and blunt.

55. *R. prostratus*. Prostrate Crowfoot. Lamarck Dict. n. 35. Fl. Francoise, n. 3. 197.—Leaves ternate, three-cleft, very hairy. Stems entirely prostrate, creeping, zigzag. Calyx smooth.—Native of dry hilly places about Paris. Lamarck and Poiret esteem this a distinct species from the last, not only because its herbage is much smaller and more hairy, but because the stems are, even when in flower, entirely prostrate. We have never met with any thing answering to this description in England. The flowers are said to resemble *repens*, having likewise a smooth calyx. Our *repens* has hairs on that part.

56. *Q. intermedius*. Intermediate Crowfoot. Lamarck Dict. n. 44.—Lower leaves three-lobed, cut; upper somewhat fingered. Flower-stalks mostly solitary. Calyx reflexed. Seeds compressed, smooth. Root fibrous.—Found at the borders of ponds in France, about Paris and at Fontainebleau. This plant, according to Poiret, is, as it were, intermediate between *bulbosus* and *repens*, having, besides, many characters in common with *prostratus*. The root is fibrous, fasciculated. Stems several, low, scarcely branched, almost leafless except at the bottom, weak, striated, slightly downy, often forked above. Radical leaves on long stalks, almost smooth, in three rounded, often cut, lobes; the stem-leaves have three linear or lanceolate irregular lobes; the uppermost are very narrow, almost fingered. Flowers axillary, or terminal, two or three on each branch, on very long and slender, nearly smooth, stalks. Calyx-leaves reflexed at the time of flowering, as in *bulbosus*, coloured, concave, bearing some very fine long hairs. Petals of a fine yellow, striated, middle-sized. Fruit oval or globose. Seeds smooth, compressed, roundish, with a green border. We know nothing of this species but from the above description.

57. *R. lucidus*. Shining-leaved Crowfoot. Lamarck Dict. n. 36.—Leaves with three or five lobes, somewhat pinnatifid, shining, smooth. Stem erect, many-flowered. Calyx reflexed.—Supposed to be a native of the Levant; cultivated

RANUNCULUS.

in the botanic garden at Paris. *Root* perennial. *Stems* one or two feet high, branched, leafy, very smooth, tender, striated. *Leaves* alternate, stalked, widely spreading, smooth, shining as if varnished on their upper surface, divided into three or five distant dilated lobes, the two lowermost contracted at their base, unequally cut, obtuse. *Footstalks* long, somewhat downy, dilated at their base into a broad membranous expansion. *Flowers* numerous, situated at the ends, as well as in the forks, of the *branches*, on long, simple, cylindrical, rather downy *stalks*. *Calyx-leaves* coloured, smooth, concave, reflexed after the flower expands. *Petals* rather large, roundish, of a fine shining yellow. This plant has some agreement with *R. repens*, from which it differs in having entirely upright *stems* and a reflexed *calyx*, as well as shorter more dilated lobes to the *leaves*. Such is Poirer's account. This surely cannot be our *palustris*, n. 52, which has hairy *leaves*, and no resemblance or affinity to *repens*; neither could the intelligent author have overlooked Tournefort's synonym for that plant.

58. *R. polyanthemus*. Many-flowered Crowfoot. Linn. Sp. Pl. 779. Fl. Succ. ed. 2. 196. Willd. n. 44. Ait. n. 28. Lamarck n. 41. Lob. Ic. 666. (*R. fylvestris* secundus; Dod. Pempt. 427. *R. furectis cauliculis*; Ger. Em. 951, as to the figure. *R. fylvestris*; Tabern. Kreuterb. 107. Ic. 42. *R. napellifolius*; Crantz fasc. 3. 90. t. 4. f. 1, 1?)—Leaves in five deep, repeatedly subdivided lobes; segments all linear. Stem erect, many-flowered. Flower-stalks furrowed. Calyx spreading. Seeds ovate, bordered, compressed, smooth.—Native of moist, elevated, rich meadows, in Upland, and elsewhere in Sweden, but rarely. Linnæus. In Germany, and perhaps in Switzerland, on the authority of various writers. *Root* perennial. *Stem* erect, two or three feet high, branched, many-flowered; leafy, clothed with upright, or somewhat spreading, hairs. *Radical* and lower *stem-leaves* three inches wide, on long very hairy stalks, divided to the very base into three lobes, the lateral lobes again divided almost to the base, so that the leaf may truly be called, in the first instance, five-lobed; each lobe is deeply, more or less repeatedly, cut, into three-cleft or alternate, linear, bluntish, entire, single-ribbed, spreading segments, loosely hairy on both sides, paler beneath: the uppermost leaves are nearly sessile, in about three deep, linear, entire divisions. *Flower-stalks* long, terminal, angular or furrowed, rough with upright hairs. *Flowers* large, yellow, drooping, not closing, in wet weather, according to Linnæus. *Calyx* spreading, pale, externally hairy. *Fruit* globose. *Seeds* ovate, short, compressed, smooth at the sides, bordered and roughish at the edges, tipped with a broad, short, recurved beak. We have described this from the authentic Linnæan specimen, which seems distinct from the following, and answers extremely well to the figure of Tabernæmontanus more especially, nor does it ill accord with that of Dodonæus, reprinted in Gerarde's herbal. The last-named author however certainly applies that figure to the common English *R. acris*, which he says he found double. Hence some doubt may arise whether the true *polyanthemos* was ever cultivated in England, as it seems to depend on Gerarde's authority only for a place in Hort. Kew. We have never seen it alive. Possibly it may be found in a double state in some old garden. The above description of the *leaves*, and the greater size of the whole plant, will distinguish it from *acris*. The *calyx* is hairy in both, notwithstanding Willdenow's remark to the contrary.

59. *R. acris*. Upright Meadow Crowfoot. Linn. Sp. Pl. 779. Willd. n. 45. Ait. n. 29. Pursh n. 15. Fl. Brit. n. 10. Engl. Bot. t. 652. Curt. Lond. fasc. 1. t. 39.

Mart. Rust. t. 30. Woodv. Suppl. t. 246. Bulliard. t. 109. Curt. Mag. t. 215. (*R. hortenensis secundus*; Dod. Pempt. 426. *R. pratensis, furectis cauliculis*; Lob. Ic. 665. *R. luteus*; Trag. Hist. 94.)—Leaves in three deep, wedge-shaped, many-cleft, jagged lobes; the lateral ones deeply divided. Stem erect, many-flowered. Flower-stalks round. Calyx spreading. Seeds ovate, bordered, compressed, smooth.—Native of meadows and pastures in all the more northern countries of Europe, very common in England, flowering in June and July. The double-flowered variety is frequent in gardens. The *root* is perennial, tuberous, with long simple fibres. *Stem* erect, two feet high, round, striated, rough with spreading hairs below, and with close-pressed ones above, branched, slightly leafy. *Leaves* hairy, far less divided than in the last, and with broader, wedge-shaped, by no means linear, segments: the upper ones linear, either deeply three-cleft, or simple. *Flower-stalks* round, not furrowed. *Calyx* green, spreading, hairy. *Petals* bright shining yellow. *Fruit* globose. *Seeds* much like the last.

A dwarf alpine variety was brought by Mr. Dawson Turner from wet rocks, near the summit of Snowdon, whose *stem* is but three or four inches high, and bears but one or two *flowers*. This when cultivated in a garden gradually assumes the size and habit of the common kind.

60. *R. Breynius*. Woolly-fruited Alpine Crowfoot. Crantz Austr. fasc. 2. 91. t. 4. f. 2. (*R. Breynius*, by mistake; Lamarck Dict. n. 59. *R. n. 1170*; Hall. Hist. v. 2. 72.)—Leaves deeply three-lobed, cut and toothed, very hairy beneath. Stems spreading, few-flowered. Calyx spreading. Seeds smooth. Receptacle woolly.—Native of the Austrian and Swiss Alps. Haller says it is the smallest of all the species. The *stems* are several, two or three inches high, oblique, simple or somewhat branched, hairy, bearing one or two *flowers*, which are of a varnished yellow. *Radical leaves* numerous, less deeply divided than in *acris*, very hairy beneath. *Fruit* globular. *Seeds* smooth, hooked. *Receptacle* woolly, which Crantz says he had not observed in other species, and by which we presume this is most essentially distinguished, particularly from the above alpine variety of *acris*. We have not met with a specimen, nor was Mr. Davall acquainted with the plant of Haller.

61. *R. lappaceus*. Bur Crowfoot.—Leaves ternate; leaflets stalked, three-lobed, sharply cut, hairy. Stem erect, many-flowered. Calyx spreading. Seeds ovate, keeled, reticulated, with elongated, revolute-pointed beaks.—Native of Port Jackson, New South Wales; communicated by Dr. White. This has much of the habit of *R. acris*, but is very distinct. The *stems* are a foot, or more, in height, branched, roundish, rough with close-pressed hairs. *Radical leaves* numerous, on long hairy stalks, very hairy, about the size of *acris* or *repens*, but remarkable for the partial stalks, sometimes an inch or two long, that support the leaflets, especially the terminal one; the *leaflets* are broad, wedge-shaped, more or less deeply three-lobed, coarsely and sharply cut. The lower *stem-leaves* are narrower and less cut; the upper entire and lanceolate; the uppermost of all simple and linear. *Flowers* larger than in *acris*, white in the dried specimen, but perhaps yellow when fresh, finely veined, on long, hairy, angular, terminal stalks. *Calyx* spreading, clothed with long hairs. *Neclary* covered with a wedge-shaped scale. *Fruit* globose. *Seeds* ovate, turgid, keeled, reticulated with veins, smooth, each tipped with a prominent angular beak, nearly its own length, whose point is strongly recurved, and even revolute.

62. *R. cappadocius*. Cappadocian Crowfoot. Willd. n. 46. Lamarck Dict. n. 39. (*R. orientalis dulcis, doronici radice*; Tourn. Cor. 20.)—*Calyx* spreading. Flower-

stalk round. Stem simple or divided. Leaves heart-shaped, three-lobed, toothed."—Native of Cappadocia. Root perennial, hard, the thickness of a goose-quill, and resembling the root of *Doronicum*. Radical leaves roundish-heart-shaped, with three very short lobes, all pointed, furnished with a few coarse teeth, and clothed on both sides with scattered close-pressed hairs. Stem-leaf solitary, stalked as well as the radical ones; and in the middle of the flower-stalk is a small, sessile, lanceolate, entire leaf. Stem a span high, clothed with close-pressed hairs, either simple, or divided above the leaf, each stalk single-flowered. Corolla yellow, the size of *R. polyanthemus*. Fruit roundish. Seeds compressed, hooked. Willdenow, from a dried specimen.

63. *R. lanuginosus*. Broad-downy-leaved Crowfoot. Linn. Sp. Pl. 779. Willd. n. 47. Ait. n. 30. Pursh n. 16. Fl. Dan. t. 397. Sm. Fl. Græc. Sibth. t. 519, unpublished. (*R. montanus subhirtus latifolius*; Bauh. Prodr. 96. *R. nemorosus hirtutus*, foliis caryophyllatæ; Loef. Pruss. 220. t. 71. *R. magnus valde hirtutus*, flore luteo; Bauh. Hilt. v. 3. 417. *R. n. 1172*; Hall. Hilt. v. 2. 73. *Βαλζυχνον ἱερὸν*; Diof. book 2. chap. 206.) Leaves heart-shaped, five-cleft, lobed, notched, silky. Stem erect, many-flowered, hairy. Flower-stalks round. Calyx spreading. Seeds ovate, compressed, with elongated, revolute-pointed beaks.—Native of Germany, France, Switzerland, Carniola, Greece, and North America. Mr. Pursh observed it in old fields and meadows, from Pennsylvania to Carolina, flowering from June to October. Dr. Sibthorp found it in shady watery situations in the Peloponnesus, but most plentifully in the north of Greece, and with great reason concluded it to be the second *Ranunculus* of Diofcorides, with whose description it sufficiently well agrees, except being mild, rather than very acrid, in sensible qualities, if we may trust modern authors. Linnæus distinguishes two varieties, between which we can discover no difference, and Haller unites them. The opinion of this great Swiss botanist however loses some of its weight, by the doubt he expresses whether this plant be distinct from *R. repens*, n. 54, to which it has indeed a slight general resemblance, though differing totally in its upright stem, destitute of runners; its very soft silky leaves, by which this plant is known at once from every other European *Ranunculus*; and the revolute taper points of its seeds, which nearly agree with *lappaceus* in that respect; but the seeds themselves are compressed, and, as far as we can see, destitute of reticulated veins. The root is perennial, with many long, stout, cylindrical, fleshy fibres, or perhaps slender knobs, intermixed with capillary branched radicles. Stem 12 or 18 inches high, branched, leafy, round, clothed with long, spreading or deflexed, hairs; its base purplish, as are also the long hairy footstalks of the radical leaves. These and the lower stem-leaves are three inches wide, divided about half way down into five or seven broad, sharply notched lobes, whose close sinuses have a pale spot, with a purple stain, adjoining to their termination. The upper leaves are deeply three-cleft, with ovate and toothed, or lanceolate and entire, lobes. Flowers yellow, much like those of *acris*. Calyx hairy, spreading. Fruit globose. Seeds with awl-shaped, strongly revolute beaks, by which this species is clearly distinguishable from *repens*, *polyanthemus*, *acris*, if such a mark were necessary, and by which it forms a chain of affinity between those species and our *lappaceus*. It is somewhat remarkable that *R. lanuginosus* has not been found in Britain, and still more so, that any obscurity should envelope the botanical history of so distinct a species.

64. *R. fericeus*. Silky Crowfoot. Lamarck Dict. n. 26. —Leaves ternate, very silky; leaflets wedge-shaped, deeply

three-cleft, jagged and toothed. Stem erect, many-flowered, silky. Calyx spreading. Seeds ovate, compressed, with short erect beaks.—Gathered in the isle of Bourbon by Commerçon, from whom we have specimens. Root, as well as the general habit and size of the plant, like the last, but the whole herb is much more densely clothed with shining silky hairs. The leaves are ternate, some of them almost twice ternate; their lobes deeply and repeatedly cut, in a radiant manner, with sharp teeth. Flowers like the last. Fruit ovate. Seeds with broad straight beaks, longer, and not so much curved or hooked, as even those of *acris*.

65. *R. tomentosus*. Shaggy Crowfoot. Lamarck Dict. n. 70. Pursh n. 17.—Leaves downy, three-lobed or notched; the uppermost oval, entire. Stem reclining, somewhat creeping, shaggy, one or two-flowered. Calyx hispid, slightly reflexed.—Gathered in North Carolina, by M. Bosc. A small, almost creeping, very hairy plant, with fibrous roots. The stems are very low, and nearly prostrate, ascending at their extremities, two or three inches long, tender, covered with whitish tufted hairs, disposed in two rows. Leaves stalked, thick, downy, generally with three lobes, which are either distinct or confluent; some leaves are merely crenate and rounded. Footstalks long and hairy. The uppermost stem-leaf is sessile, oval, acute, entire. Flowers one or two, on terminal, unequal, simple stalks, clothed with two rows of hairs. Calyx hispid, a little reflexed. Petals white or yellowish, rounded at the end. Poiret. We have seen no specimen, nor did Mr. Pursh meet with the plant himself.

66. *R. marylandicus*. Maryland Crowfoot. Lamarck Dict. n. 69. Pursh n. 18. Leaves ternate, three-lobed, acute, cut, pale and nearly smooth beneath. Stem simple, almost naked, downy. Calyx smooth, reflexed. Found in shady woods, from Pennsylvania to Virginia, flowering from May to July. Pursh. Root fibrous, perennial. Stems simple, erect, downy, slender, about ten inches high; Poiret by mistake, as we presume, says ten feet. Leaves radical, on long downy stalks, ternate; the two lateral ones opposite, stalked; all with three confluent, lanceolate, acute, cut lobes; their upper surface green; the under paler and whitish, almost smooth. There are no other stem-leaves than what stand almost sessile, at the base of the flower-stalks, and either have three or five shallow irregular lobes, or are simply cut. Flowers two or three, terminal, on short, scarcely downy, stalks. Calyx smooth, reflexed. Petals rather large, oval, rounded at the end, pale yellow. Poiret.

67. *R. recurvatus*. Recurved Crowfoot. Lamarck Dict. n. 65. Pursh n. 19.—Leaves in three deep, acute, cut, wedge-shaped lobes. Stem many-flowered. Calyx and corolla reflexed. Petals nearly linear. Seeds compressed, dotted, with revolute, awl-shaped beaks.—Native of shady woods, from New York to Carolina, flowering from June to August. Pursh. We received specimens from the Rev. Dr. Muhlenberg, of Lancaster, Pennsylvania. The root is perennial. Stems a span high, very hairy; branched and leafy at the upper part. Leaves two or three inches wide, rather hairy, on very hairy stalks; their side-lobes for the most part deeply cleft. Flowers stalked, small. Calyx pale-purplish, ribbed, clothed with fine long hairs. Petals small, narrow, almost white. Fruit globose. Seeds ovate, lenticular, minutely dotted, smooth, with slender, revolute-pointed beaks.

68. *R. septentrionalis*. Smooth North-American Crowfoot. Lamarck Dict. n. 64. Pursh n. 20.—Leaves ternate, membranous, smooth, deeply lobed, acute, cut. Stem two-flowered, hairy, like the base of the footstalks. Calyx reflexed.

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reflexed.—Native of North America. Described by Poirer from Lamarck's herbarium, and adopted by Pursh. *Root* perennial, fibrous, fasciculated. *Stems* nearly simple, hollow, eight or ten inches high, almost leafless; downy in their lower part. *Leaves* stalked, thin, smooth, composed of three stalked leaflets, the central one having three deep spreading lobes, the others often but two; all sharp, cut and toothed. There is usually but one *stem-leaf*, which is nearly sessile, ternate, with narrower segments. *Footstalks* long, slender, most hairy towards their base. *Flower-stalks* two, terminal, unequal, very slender, smooth, each bearing, about half way up, one small linear leaf. *Calyx* reflexed, coloured, smooth, except a few terminal hairs, deciduous. *Petals* pale yellow, rounded. *Fruit* small, globular. *Seeds* nearly orbicular, lenticular, with sharp straight beaks. *Poirer*.

69. *R. hispidus*. Hispid American Crowfoot. Michaux Boreal-Amer. v. 1. 321. Lamarck Dict. n. 27. Pursh n. 21.—Very hairy, erect. Leaves ternate, sharply lobed. Stems few-flowered; leafless below. Calyx close-pressed. Seeds obovate, with awl-shaped, inflexed beaks. Found in wet fields, and on the banks of ditches, from Virginia to Carolina, flowering from June to August. *Root* perennial. *Flowers* small, pale yellow. *Pursh*. A specimen sent by Gronovius to Linnæus, as akin to his *lanuginosus*, but distinct, answers very well to the characters of Michaux, and we have taken from that specimen the above account of the seeds. The flower is nearly as big as *acris*. Whole herbage; especially the *footstalks*, very hairy.

70. *R. pinnatus*. Pinnated Indian Crowfoot. Poirer in Lam. Dict. n. 66.—“Downy. Leaves pinnated; leaflets lobed and cut. Branches spreading. Seeds tuberculated.”—Gathered in India by Sonnerat. *Stems* with lax, spreading, downy, striated, leafy branches. *Leaves* alternate, stalked, downy, of five or seven opposite leaflets, divided into irregular, sharp, cut, almost lanceolate, lobes. *Flowers* numerous, on long, downy, single-flowered stalks. *Calyx* coloured, not reflexed. *Petals* yellowish, of a middling size. *Seeds* orbicular, convex, moderately tuberculated on each side, and tipped with a small, thick, straightish beak. *Poirer*.

71. *R. multifidus*. Many-cleft Arabian Crowfoot.—Forsk. Ægypt-Arab. 102. Lamarck Dict. n. 67.—“Leaves many-cleft; the lower ones pinnated. Stem many-flowered. Calyx the length of the corolla. Seeds ovate, acute.—Gathered by Forskall, in ditches near the town of Taes. He describes the *stem* two feet high, erect; round in the lower part; striated above; hairy. *Fruit* oval. We have no other authority, than the authors quoted, for this species or the last.

72. *R. pedatifidus*. Radiating-leaved Crowfoot.—Leaves deeply pedatifid, with linear, obtuse, divided or three-cleft, radiating, entire segments. Stem one or two-flowered. Seeds ovate, hairy, with small recurved beaks.—Native of Siberia. Four specimens from that country are in the Linnæan herbarium, but the species, though very distinct, appears never to have been described. *Root* perennial, of many long, cylindrical, fleshy fibres, and crowned with numerous capillary remains of old footstalks. *Stem* a span high, erect, round, striated, leafy, simple or divided, clothed with long, soft, lax hairs. *Radical leaves* on long hairy stalks, deeply cut, in a pedate manner, into five, seven, or more, narrow, linear, obtuse, elegantly radiating segments, some of which are deeply three-cleft, and their lobes again cloven, others merely divided, and others undivided; all entire at the edges, and somewhat hairy on both sides, with long, lax, white hairs. The *stem-leaves* are mostly sessile, less divided; the uppermost in three, rarely

more, deep, linear, simple segments. *Flowers* apparently yellow, the size of *R. acris*. *Calyx* woolly at the base; its segments partly dilated and coloured, all shorter than the petals, and closely pressed to their under side. *Fruit* ovate. *Seeds* not very numerous, ovate, tumid, hairy, with short, awl-shaped, reflexed beaks.

73. *R. cherophylos*. Chervil Crowfoot. Linn. Sp. Pl. 780. Willd. n. 48. Lamarck Dict. n. 32. (*R. tenuifolius luteus*, grumosa radice, forasteris seu italicus; Barrel. Ic. t. 581? bad.)—Leaves thrice compound, with linear segments. Stem silky, with few flowers. Calyx reflexed, hairy. Root with tapering fleshy fibres.—Native of the south of Europe. The only certain specimen of this plant, that has ever come under our observation, exists in the Linnæan herbarium. The *root* consists of numerous, long, fleshy, gradually tapering, downy fibres. *Stem* erect, about a span high, slender, silky, slightly leafy, branched, bearing three or four flowers. *Radical leaves* several, stalked, repeatedly ternate, with numerous linear, or somewhat lanceolate, entire segments, hairy beneath. *Footstalks* an inch and half long, hairy; dilated, membranous, and ribbed at the base. *Stem-leaves* few, much less compound, and often nearly sessile. *Flowers* solitary, on long, terminal, simple, hairy, quadrangular stalks. *Calyx* strongly reflexed, coloured; externally hairy. *Petals* yellow. *Fruit* not sufficiently advanced to be described. At the back of this specimen Linnæus has written *Ranunculus lybicus, pulsatilla folio, T. Cor.*; but there is no such passage in Tournefort's *Corolla*, nor any thing to which it can refer, except *R. lybicus, pulsatilla folio, flore parvo*, a species unknown to us. A very different plant from the true *R. cherophylos*, was given by the abbé Pourret to the younger Linnæus, under that name. It seems rather to be *flabellatus*, n. 32, a species allied, in many points, to what we are describing.

74. *R. millefoliatus*. Milfoil Crowfoot. Vahl. Symb. v. 2. 63. t. 37. Desfont. Atlant. v. 1. 441. t. 116. Willd. n. 49. Lamarck Dict. n. 33. Sm. Fl. Græc. Sibth. t. 521, unpublished. (*R. montanus leptophyllon, asphodeli radice*; Column. Ecphr. 312. t. 311.)—Leaves thrice compound, with elliptic-linear segments. Stem silky, with few flowers. Calyx erect, somewhat hairy. Root with ovate knobs.—Native of Italy, Greece, Syria, and Barbary. The *root*, in Dr. Sibthorp's specimens, consists of many oval fleshy knobs, scarcely half an inch long, intermixed with fibres. Columna describes and delineates the fibres as terminating the knobs; a very material difference. The *stems*, in the Greek and Italian specimens, are simple and single-flowered; in the more luxuriant ones from Aleppo and Tunis, somewhat branched, bearing two or three flowers. The *stem-leaves* are more numerous, as well as more compound, than in the last. *Flowers* large. *Calyx* closely pressed to the corolla; sometimes nearly smooth. *Fruit* oblong. *Seeds* with small recurved beaks. We can scarcely doubt, notwithstanding the above-mentioned diversity respecting the *root*, that the synonym of Columna belongs to the present, rather than the foregoing, species.

75. *R. oxyspermus*. Sharp-leaved Crowfoot. Willd. n. 51. Lamarck Dict. n. 37.—“Radical leaves oblong, obtuse, deeply and unequally toothed; stem-leaves sessile, fingered, cut. Seeds awned.”—Native of Siberia, near the river Tereck. *Root* apparently annual. *Radical leaves* stalked, ovate, obtuse, with unequal deep teeth; hairy, like their *footstalks*, on both sides. *Stem* erect, branched, hairy, a foot or more in height. *Stem-leaves* digitate; the segments of the lower ones unequally pinnatifid; of the upper linear and entire. *Calyx* reflexed. *Corolla* yellow, the size of *R. bulbosus*. *Fruit* elliptical. *Seeds* rather compressed, acute,

acute, with upright, awl-shaped, bristly points. *Willdenow.*

76. *R. arvensis*. Corn Crowfoot. Linn. Sp. Pl. 780. Willd. n. 52. Ait. n. 32. Fl. Brit. n. 12. Engl. Bot. t. 135. Curt. Lond. fasc. 6. t. 36. Mart. Rust. t. 56. Fl. Dan. t. 219. Bulliard. t. 117. Brugnion Mem. de l'Acad. de Turin, v. 4. 108. t. 3. (*R. arvorum*; Ger. Em. 951.)—Leaves ternate, three-cleft, with linear segments. Seeds prickly at each side. Stem erect.—Frequent in corn-fields throughout Europe, flowering in the middle of summer. Root fibrous, annual. Stem one or two feet high, much branched, many-flowered, leafy, nearly smooth. Leaves of a light green, slightly hairy, stalked, once or twice ternate, as well as deeply three-cleft; the ultimate segments almost linear, entire, or rarely notched. Flowers small, lemon-coloured, stalked, lateral and terminal. Calyx spreading, hairy. Petals obovate, veined. Fruit depressed. Seeds very large, compressed, with erect, awl-shaped, hooked beaks; their sides armed with numerous, prominent, awl-shaped prickles, largest towards the margin. From the observations of M. Brugnion, this appears to be one of the most virulent of its genus, especially when young, causing speedy inflammation and gangrene in the stomachs of sheep and oxen; who nevertheless eat it with avidity. Vinegar much diluted with water, poured down their throats, proved a quick and certain remedy. The expressed juice of the plant, given to dogs, is no less fatal.

77. *R. muricatus*. Spreading Prickly-seeded Crowfoot. Linn. Sp. Pl. 780. Willd. n. 53. Lamarck Dict. n. 75. Ait. n. 33. Pursh n. 24. Sm. Fl. Græc. Sibth. t. 522, unpublished. (*R. creticus echinatus latifolius*; Alpin. Exot. 263. t. 262. *R. Apulei quibusdam*; Clus. Hist. v. 1. 233. *R. parvus echinatus*; Ger. Em. 965. *R. palustris echinatus*; Bauh. Hist. v. 3. 846. Feuille. Peruv. 58. t. 18. f. 1.)—Leaves simple, three-lobed, notched, bluntnish, smooth. Stipulas distantly fringed. Seeds prickly at each side. Stem diffuse.—Native of watery places in various parts of the south of Europe; frequent in Greece. It occurs also in North America, in old fields, from Virginia to Carolina, flowering in June and July, according to Mr. Pursh. The root is annual, consisting of numerous long fibres. Herb smooth and succulent, bright green. Stems several, various in length, spreading, and mostly procumbent, leafy, round, shining; purplish in the lower part. Leaves an inch and a half to three inches wide, veiny, in three rather deep lobes, broadly and irregularly notched. Footstalks from one to four inches, or more, in length, with a concave sheathing base, bordered with a membranous stipula, whose edges are regularly fringed with distant hairs. Flowers the size of the last, yellow, solitary, on axillary stalks, rather shorter than the leaves. Calyx reflexed, nearly, or quite, smooth. Petals obovate, almost twice as long as the calyx, at least in the European specimens, though they appear to be but of the same length in American ones. Fruit capitate. Seeds large, ovate, compressed, with broad, awl-shaped, angular, somewhat recurved beaks; their sides covered with smaller, more uniform prickles, than in *R. arvensis*. Commerçon gathered, by the sea-shore at Monte Video, a variety of this with more luxuriant herbage, and smaller flowers, of which Ventenat makes a species of the name of *ventricosus*, founding its character on the inflated bases of the footstalks, of which, however, we can see nothing, in our original specimens from Thouin's herbarium. Its stipulas are fringed precisely as in our European *muricatus*, to which we agree with Poiret in referring it, though we can scarcely do the same by the following.

78. *R. echinatus*. Dwarf Prickly-seeded Crowfoot. Venten. Jard. de Cels t. 73. Pursh n. 25. (*R. muricatus* γ; Lamarck Dict. n. 75.)—Leaves simple, three-lobed, notched, smooth. Stipulas bearded at the summit. Seeds prickly at each side. Stem erect, branched.—Found by M. Bosc, near Charlestown, South Carolina. This seems to differ from the last, in its simple, short, upright stem; but more especially, if Ventenat's plate and description be correct, which we cannot doubt, in having each stipula crowned with a tuft of hairs, instead of being distantly fringed throughout. The petals are said to be larger than those of the American variety, at least, of *muricatus*; but that circumstance is of small moment here, as to a specific distinction.

79. *R. parviflorus*. Small-flowered Crowfoot. Linn. Sp. Pl. 780. Willd. n. 54. Ait. n. 34. Fl. Brit. n. 13. Engl. Bot. t. 120. (*R. hirsutus annuus, flore minimo*; Raii Syn. 248. t. 12. f. 1. Pluk. Phyt. t. 55. f. 1.)—Leaves simple, three-lobed, notched, hairy. Seeds covered, at each side, with hooked prickles; their beaks recurved. Stem diffuse.—Native of the more temperate parts of Europe. Found on banks, and in waste as well as cultivated ground, in England, where the soil is gravelly; as also in Greece, flowering in the early part of summer. The root is annual. Stems prostrate. Whole herb hairy, smaller in every part than *R. muricatus*. Flower-stalks opposite to the leaves. Petals pale yellow, scarcely longer than the spreading calyx, fugacious, and often imperfect. Fruit capitate. Seeds ovate, with a broad, short, hooked beak, their flat brown sides densely covered with short, hooked prickles. *R. trilobus*, Desfont. Atlant. v. 1. 437. t. 113. Lamarck Dict. n. 77, seems a variety, not of this, but of our *hirsutus*, n. 51.

80. *R. orientalis*. Spinous Oriental Crowfoot. Linn. Sp. Pl. 781. Willd. n. 55. Lamarck Dict. n. 71. (*R. lesbius, pulsatilla folio, flore magno*; Tourn. Cor. 20.)—Leaves deeply lacinated, acute; all stalked. Stem branched. Calyx reflexed. Fruit cylindrical. Seeds dotted; their beaks recurved and spinous.—Native of the Levant. Root annual. Stem various in luxuriance, silky, leafy; in the Linnæan specimen much branched and divaricated, with many flowers. Leaves stalked, composed in general of three deeply lacinated, often pinnatifid, acute, hairy leaflets. Flowers large, pale yellow, on long, stout, simple, lateral or terminal, solitary, spreading stalks. Calyx rather spreading than decidedly reflexed, nearly smooth. Fruit three quarters of an inch long, slightly elliptical, obtuse. Seeds in many rows, compressed, minutely dotted at each side, gibbous at the base, each terminating in a very broad, rather short, compressed, recurved, spinous-pointed beak. We know of no figure of this or the following.

81. *R. grandiflorus*. Large-flowered Oriental Crowfoot. Linn. Sp. Pl. 781. Willd. n. 56. Lamarck Dict. n. 63. (*R. orientalis, aconiti folio, flore luteo maximo*; Tourn. Cor. 20.)—"Stem erect, two-leaved. Leaves many-cleft; those of the stem alternate, sessile."—Gathered by Tournefort in the Levant. We have seen no specimen. Willdenow marks this as a perennial species, and indicates his having seen it in a dried state. We regret that he did not subjoin a description of the plant, the Linnæan specific character being very insufficient. What Poiret has given is evidently compiled from the short materials furnished by Linnæus and Tournefort. The Abbé Sestini is said to have gathered *R. grandiflorus* near Constantinople; on whose authority it finds a place in Prodr. Fl. Græc. v. 1. 385.

82. *R. falcatus*. Sickle-seeded Crowfoot. Linn. Sp. Pl.

Pl. 781. Willd. n. 57. Ait. n. 35. Jacq. Austr. t. 48. (*Melampyrum luteum*; Ger. Em. 90. Lob. Ic. 37.)—Leaves linear-wedge-shaped, in three deep many-cleft lobes. Seeds with sickle-shaped beaks. Stalks radical, single-flowered.—Native of corn-fields in the south of Europe, and the Levant; cultivated by Miller at Chelsea in 1739. A small annual, flowering in the early part of summer. Root thread-shaped, with a few fibres. Stem none. Leaves several, pale green, downy, about two inches long; their segments narrow and entire. Stalks simple, downy, taller than the leaves, each bearing a small yellow flower, whose calyx is erect. Fruit large, ovate, or nearly cylindrical, beset on all sides with the long, prominent, ascending, incurved, compressed, downy, spinous-pointed beaks of the seeds.

83. *R. polyphyllus*. Many-leaved Water Crowfoot. "Waldst. et Kitaibel Hung." Willd. n. 58.—"Leaves under water oblong, stalked, capillary; floating ones wedge-shaped, three-lobed; those above the water elliptical. Stem erect."—Native of the waters of Hungary. Annual. Stem nine inches high, erect; branched in the upper part. Leaves that are under water very numerous, entirely covering that part of the stem, oblong, the length of the nail, each supported by a capillary footstalk an inch long: the floating leaves small, wedge-shaped, three-lobed, entire, as long as the former, their footstalks thicker and shorter. Branches an inch long, erect, rising above the water, and bearing elliptical obtuse leaves, tapering each way, from four to six lines long, on short footstalks. Flowers extremely small, yellow. Willdenow.

84. *R. hederaceus*. Ivy Crowfoot. Linn. Sp. Pl. 781. Willd. n. 59. Ait. n. 36. Fl. Brit. n. 14. Engl. Bot. t. 2003. Curt. Lond. fasc. 4. t. 39. Fl. Dan. t. 321. Dalech. Hist. 1031. (*R. hederaceus rivulorum* se extendens, atrâ maculâ notatus; Bauh. Hist. v. 3. 774.)—Leaves smooth, roundish, kidney-shaped, with three or five entire lobes. Stem creeping. Stamens from five to ten. Seeds corrugated.—Native of watery places, on a sandy or gravelly soil, in England, Germany, France, &c. flowering from May to August. Roots fibrous, perennial. Stems either creeping or floating, prostrate, branched, round, smooth, and succulent. Leaves stalked, smooth, and shining, nearly uniform; often blackish in the disk. Flowers very small, on simple, axillary or lateral, stalks. Petals linear-oblong, rather exceeding the calyx in length, white, with yellow claws. Stamens scarcely ever more than ten. Fruit globose. Seeds ovate, incurved, somewhat compressed, with a very small inflexed beak, and numerous, lateral, corrugated or reticulated veins.

85. *R. aquatilis*. White Floating Crowfoot. Linn. Sp. Pl. 781. Willd. n. 60. Ait. n. 37. Fl. Brit. n. 15. Engl. Bot. t. 101. Ger. Em. 829.—Leaves capillary under water; above somewhat peltate. Stamens numerous. Seeds corrugated.—Native of pools, ditches, and rivers, throughout Europe, mantling the surface with its copious white blossoms, in the early part of summer. The roots are long, fibrous, and perennial. Stems floating under water, long, round, branched, leafy. Leaves stalked, smooth; the uppermost floating, usually peltate, with various blunt notches; the next deeply three-lobed, or even ternate; the lowermost immersed, repeatedly three-cleft, with innumerable capillary segments. Flowers floating on long simple stalks, opposite to the leaves. Petals obovate, much longer than the calyx, white, with yellow claws. Nectary tubular. Stamens thirty or more. Fruit like the last, but the seeds more numerous, and generally bristly, somewhat obovate.

Varieties, as we deem them, of this species are, 1st, that whose leaves are all immersed, and entirely capillary, figured in Ger. Em. 827. f. 3: 2dly, the *circinatus* of Sibth. Oxon. 175, figured in Pluk. Phyt. t. 55. f. 2, whose leaves are all likewise in capillary divisions, but finer and smaller than the former: 3dly, the *fluvialis* of Willdenow, n. 61, *peucedanoides* of Desfont. Atlant. v. 1. 444, figured in Fl. Dan. t. 376, whose leaves are not only in capillary segments, but considerably elongated, by the influence, as we conceive, of the running water, in which this sort is always found. The seeds indeed are not bristly, in our specimens of this last variety, but naked, as in *hederaceus*, which species agrees with every variety of *aquatilis*, in the corrugations of the seeds, as above described.

We have thus added twenty-four species to Willdenow's number, following his arrangement, for the present at least; not only for the convenience of our readers, but because it would be very difficult to make a perfect one on any known principles; the several species being allied by too many characters, and so dissimilar in others, that nothing could be more precarious than to seek the clue of nature through such a labyrinth. The seeds perhaps ought to form the basis of a specific arrangement, if they might not even lead to generic distinctions.

No small curiosity in the history of this genus is the *R. alatus*, of Poiret in Lamarck's Dict. n. 72, which, by his description, proves to be no other than *Gymnosyles pterisperma* of Jussieu. (See GYMNSTYLES.) The *pumilus* of Poiret, n. 82, appears to us a variety of *aquatilis*, growing in shallow, and perhaps fluctuating, waters; whence, though its leaves are all deeply cut, their segments are not quite capillary, but linear and obtuse. We have Swift's specimens answering to this author's description.

RANUNCULUS, in Gardening, contains plants of the hardy, herbaceous, perennial kind, of which the species cultivated are, the Persian crowfoot, or garden ranunculus, (*R. asiaticus*); the aconite-leaved crowfoot (*R. aconitifolius*); the upright meadow crowfoot (*R. acris*); the creeping crowfoot (*R. repens*); and the embracing-leaved crowfoot (*R. amplexicaulis*). But there are other species that may be cultivated for variety.

Of the first species the varieties are exceedingly numerous, being sometimes divided into two classes, as the old Turkey kinds, and the Persian kinds, the varieties of the latter amounting to many hundreds, and being considerably more various, rich, and beautiful in colour than those of the others.

But in the former of these sorts they rise with a strong generally unbranching stalk a foot high, terminated by one large double flower, sometimes emitting one or two smaller ones from its sides, and of which there are red-flowered, scarlet-flowered, yellow-flowered, and scarlet turban-flowered, &c.; but being seldom tinged with different colours, as in the Persian kinds.

And in the latter kind the plants rise eight or nine inches high, generally branching from the bottom, producing from five or ten to twenty or more flowers on each root, and of which there are single-flowered, semi-double-flowered, full-double-flowered, large and full like a double rose, being generally filled with petals to the very centre, forming a regular globular body, of admirable elegance, of all sorts of the most beautiful colours in different varieties, and of numerous degrees of deeper and lighter shades, stripes, and tinges in the several colours. Indeed Martyn observes, that the varieties produced of late years from the seeds of semi-double flowers are unbounded; and that Mr. Maddock remarks that they are more numerous than of any other

other flower. Accordingly his catalogue, he says, boasts nearly eight hundred, all with their proper names: ranged under the heads of—dark and dark purple; light purple and grey, &c.; crimson, &c.; reds, &c.; rosy, &c.; orange, &c.; yellow and yellow spotted, &c.; white and white spotted, &c.; olive, &c.; purple and coffee-striped, &c.; red and yellow-striped; red and white striped.

And according to the above flower gardener a fine ranunculus should have a strong straight stem from eight to twelve inches high. The flower should be of an hemispherical form, at least two inches in diameter, consisting of numerous petals gradually diminishing in size to the centre, lying over each other, so as neither to be too close nor too much separated, but having more of a perpendicular than horizontal direction, in order to display the colours with better effect. The petals should be broad, with entire well-rounded edges; their colours dark, clear, rich or brilliant, either of one colour or variously diversified, on an ash, white, sulphur or fire-coloured ground, or else regularly striped, spotted or mottled, in an elegant manner.

In the second species there is a variety with double flowers, which has been obtained by seeds, and is preserved in many curious gardens for the beauty of its flowers. It is by some gardeners called the *Fair Maid of France*. The root is perennial, and composed of many strong fibres: the leaves are divided into fine lanceolate lobes: the four side-lobes are upon footstalks coming from the side of the principal stalk, and the middle one terminates it; they are deeply serrate, and have several longitudinal veins. The stalks rise a foot and half high, and branch out at the top into three or four divisions, at each of which there is one leaf, of the same shape with the lower, but smaller. The flowers are pure white, and very double, each standing upon a short footstalk. The flowers come forth in May.

In the third sort there is also a variety with double flowers, which is the sort most generally cultivated in the garden. It is frequently among other herbaceous perennials, under the name of *Yellow Bachelor's Buttons*.

And in the fourth species there is a variety with double flowers, which is the sort cultivated in the gardens for its ornamental effects.

Method of Culture.—The first sort and different varieties may be readily increased by the off-sets taken from the root, and new varieties may be raised from seed. In the first of these methods the off-sets should be separated from the roots in dry weather, in the latter end of summer, when the flowering is over, and the stems and leaves are declining, being placed in bags or boxes, in a dry place, till the autumn, when they should be planted out in rows six or eight inches apart, and six of them to each, in separate beds, prepared with light sandy earthy compost, to the depth of two or three feet; taking care to protect them carefully from the frost during the winter. When the buds begin to break through the ground they should be kept perfectly clear from weeds, protecting them from frosts; and when they have flowered and the stems are decayed, the root should be taken up; cleared from dirt, and placed in bags or boxes till the autumn, when they must be planted again.

But in the second mode, the seed should be collected from the best plants of the semi-double kinds, and be sown in flat pans or boxes, filled with light rich earth, in August, covering it in about a quarter of an inch thick with the same sort of earth, placing them in a shady situation, so as to have a little of the morning sun. The pots should remain here till the beginning of October, when the plants sometimes appear,

though it is often later before this happens, when they should have a more open exposure with the full sun; but when frost is apprehended, they should be removed under a common hot-bed frame, being only covered in the nights and bad weather with the glasses, guarding them well against rains and frost. In the spring following they should be exposed to the open air, being very slightly refreshed with water, having a situation to enjoy the morning sun; and when their leaves and stems begin to decay, the roots may be taken up, dried in a proper place, and then put up in bags to be planted out in the same manner as the old roots in October.

In the following summer they will produce flowers; when such as are good should be marked, and the others removed from them. The plants intended to flower should not be suffered to run to seed, as roots which have produced seeds seldom furnish fine flowers afterwards. The disappointments experienced in purchasing these roots, chiefly depend upon this circumstance.

It may be noticed that the roots intended for the borders should be planted towards the spring in little clumps or patches, three, four, or five roots in each, putting them in either with a dibble or trowel, about two inches deep, and three or four asunder in each patch, and the patches from about three to five or ten feet distance, placing them in a varied manner in the borders.

And in regard to their general culture after planting, such of the forward autumnal-planted roots of the choice sorts in beds as have shot above ground, should in winter, where convenient, have occasional shelter from hard frosts, by mats supported on low hoop arches; or in very severe weather be covered close with dry long litter, removing all covering in open weather: and in the spring, when the flower-buds begin first to advance, shelter them in frosty nights with supported mats, suffering them, however, to be open to the full air every day; but the latter plantings, that do not come up in winter, or very early in spring, whilst frosty nights prevail, will not require any protection, and all those distributed in patches about the borders must also take their chance in all weathers: those of the different seasons of planting will succeed one another in flowering from the beginning of April until the middle of June, though the May blow generally shews to the greatest perfection. After the blow is past, and the leaves and stalks withered, the roots should be taken up and dried in the shade, then cleared from all off-sets and adhering mould, putting them up in bags or boxes till next planting season, when they must be planted again, as directed above.

But in each season of planting, it is highly necessary, in the principal fine varieties, to put them either in entire new beds, or the old ones refreshed with some fresh rich earth or compost, working the old and new well together, in order to invigorate the growth of the plants.

All the other species are capable of being easily raised by the roots, which should be slipped or parted in autumn when past flowering, or in the spring before they begin to shoot, and the slips be either planted at once, where they are to remain, or in nursery-rows for a season, then planted out finally. They succeed in any common soil and situation, and may be dispersed about the different flower-borders and clumps, where they constantly remain, only trimming them occasionally; and once in a year or two, or when they have increased into large bunches, taking them up in autumn or spring, to divide them for further increase, replanting them again directly.

In saving seed for raising new varieties, it must be suffered to continue on the plant till it becomes brown and dry,

dry, then be cut off, with the heads, and spread upon paper, in a dry room, exposed to the sun, and when quite dry, be put into a bag, and hung in a dry place till it is wanted.

All these plants are highly ornamental; the first sort in beds and pots, and the other in the borders, clumps, and other parts of pleasure-grounds.

RANUNCULUS, *Globe*, in *Botany*. See *HELLEBORE*.

RANUNCULUS Viridis, in *Zoology*, the name of an animal common in many parts of the world, and usually known by the name of the *tree-frog*, or *rana arborea*.

The creature is easily distinguished from the common frog, by its being much smaller, and of a green colour. It usually sits upon the leaves of trees and shrubs, and makes a great noise in an evening; but that is rather like the singing of a small bird than the croaking of a frog.

These creatures have been kept alive many years together in glass vessels, giving them flies and other small insects: and in winter, when these are scarce, they usually become very lean and feeble; but in summer, when they are plentiful, they will grow fat again, as if at their liberty. This is esteemed a poisonous creature. Ray. See *RANA*.

RANZ des Vaches, a celebrated air among the Swiss, played upon the bagpipe by the young cow-keepers on the mountains. The air will be found on our music-plates. In the article *Music*, the powerful effects of this tune are mentioned, from Rouslean's *Dict. de Musique*.

RAOLCONDA, in *Geography*, the seat of a diamond-mine in Hindoostan, placed in Mr. Montresor's map about 15 geographical miles to the west of Ralicotte, and 12 from the north bank of the Kistnah, but Mr. Rennell does not know what authority he has for this position. Tavernier, who visited Raolconda, gives its distance from Golconda at 17 gos, of 4 French leagues each. He crossed a river that formed the common boundary of Golconda and Visapour, about four gos, or more, before he came to Raolconda; and this river can be no other than the Beemah, which to this day forms the eastern boundary of Visapour, and passes about 80 or 82 miles to the west of Golconda, crossing the road from it to Ralicotte. If we reckon the 82 miles at 13 gos, that is, forming a scale from the distance between Golconda and the river Beemah, each gos will be 6.3 geographical miles in horizontal distance (or nearer three than four French leagues); and Raolconda will be placed about 25 geographical miles on the W. of the Beemah, or 11 E. of Ralicotte.

RAON L'ETAPE, a town of France, in the department of the Vosges, and chief place of a canton, in the district of St. Dié, on the Meurte; 7 miles N. of St. Dié. The place contains 2528, and the canton 5300 inhabitants, on a territory of 70 kilometres, in 5 communes.

RAOUDA, or *ROUDDA*, denoting *gardens*, an island of Egypt, in the Nile, in front of Old Cairo, about 500 yards in breadth, where is built the *Mekkias*, signifying measure, or Nilometer, a pillar, by the gradations on which the rise of the Nile is measured.

This island is called Roudd, or gardens, because it is laid out in gardens, and inhabited only by gardeners.

RAOUTTY, a town of Hindoostan, in Malwa; 20 miles N.N.E. of Tandla.

RAPA, in *Botany*, (an ancient name, of whose etymology no plausible account has come to our knowledge,) the Turnip. See *BRASSICA*, species 7.

RAPAAPO, in *Geography*, a town of America, in New Jersey; 30 miles S. of Woodbury.

RAPACIOUS ANIMALS, in the general, are such as live upon prey.

Naturalists divide birds into *rapacious*, *carnivorous*, and *frugivorous*.

The characteristic notes of rapacious birds, which are the Accipitres of Linnaeus, are, that they have a great head, and a short neck; hooked, strong, and sharp-pointed beak and talons, fitted for tearing of flesh; strong and brawny thighs, for striking down their prey; a broad thick fleshy tongue, like that of man; twelve feathers in their train; and twenty-four flag-feathers in each wing, and the two appendices, or blind guts, are always very short.

Rapacious birds have a membranous stomach; and not a muscular one, or a gizzard, such as birds have which live on grain.

They are very sharp-sighted, and gather not in flocks; but, generally speaking, are solitary; though vultures will fly fifty or sixty in a company.

RAPAKIVI, in *Mineralogy*, a name given to the aggregate of felspar and mica: its colour is brown, or brownish-red; it moulders by exposure to the air, but that is only when the mica is in excess. When the felspar exceeds, it forms a durable stone, called in Italy "*Granitone*." Kirwan.

RAPALLO, in *Geography*, a town of the Ligurian republic, situated on a bay to which it gives name; 12 miles E.S.E. of Genoa.

RAPANEA, in *Botany*, according to De Theis, its vernacular name in Guiana; though Aublet says nothing to that effect.—Aubl. Guian. v. 1. 121. Juss. 288. Lamarck Illustr. t. 122.—Class and order, *Pentandria Monogynia*. Nat. Ord. *Berberides*, or rather perhaps *Rhamni*, or *Sapote*; Juss.

Gen. Ch. *Cal.* Perianth inferior, minute, of one leaf, with five or six teeth, permanent. *Cor.* of one petal; tube very short; limb in five or six deep roundish segments. *Stam.* Filaments five or six, inserted into the tube at the base of each lobe of the limb; anthers oblong, quadrangular, of two cells. *Pist.* Germen superior, roundish, of five or six cells; style very short; stigma obtuse. *Peric.* Drupa globular, of one cell. Seed solitary, globose.

Ess. Ch. Corolla in five or six deep segments, opposite to the stamens. Anthers quadrangular. Drupa superior. Seed solitary, globose.

1. *R. guianensis*. Aubl. Guian. t. 46. (Samara floribunda; Willd. Sp. Pl. v. 1. 665.)—Native of thickets, in the skirts of meadows, in Cayenne and Guiana, bearing flowers and fruit in December. A small tree, whose trunk is five or six feet high, and four or five inches thick, crowned with branches; the wood white, not very compact. Leaves alternate, on short stalks, obovate, bluntish, entire, smooth, two or three inches long, with one rib, and many transverse veins scarcely visible when fresh. Flowers copious, small, white, in dense lateral tufts. Fruit violet-coloured.—Mr. Brown, in his *Prodromus Nov. Holl.* v. 1. 533, speaks of this shrub as belonging to the genus *MYRSINE*, see that article; consequently Jussieu was most correct in hinting its affinity to his *Sapota*, an order from which Ventenat and Brown have separated their more recent one of *MYRSINE*, to which we refer the reader.

RAPATEA, apparently a vernacular name of the plant in Guiana, Aubl. Guian. v. 1. 305. t. 118. Juss. 44. Lamarck Illustr. t. 226. See *MNASIUM*.

RAPAX, in *Ichthyology*, a name given by Schoneveldt to the *corvus piscis* of some writers, a species of chub or cyprin, called *rappe* by the Germans, and by Gesner and others *capito fluviatilis rapax*.

RAPE, *RAPTUS*, in *Law*, a *ravishing*; or the having carnal knowledge of a woman by force, and against her will.

will. If the woman conceived, the law formerly esteemed it no rape; from an opinion, that she cannot conceive, unless she consented. But this opinion has been since questioned. Coke on Litt. lib. ii. cap. 11.

This crime, by the Jewish law, Deut. xxii. 25. was punished with death, in case the damsel was betrothed to another man; and in case she was not betrothed, then a heavy fine of fifty shekels was to be paid to the damsel's father, and she was to be the wife of the ravisher all the days of his life; without that power of divorce, which was in general permitted by the Mosaic law.

The civil law (cod. 9. tit. 13.) punishes the crime of ravishment with death and confiscation of goods; including under this crime both the offence of forcible abduction, and also that of forcibly dishonouring; either of which, without the other, is in that law sufficient to constitute a capital crime. And the stealing away a woman from her parents or guardians, and debauching her, is equally penal by the emperor's edict, whether the consent, or is forced.

Rape was punished by the Saxon laws, particularly those of king Athelstan, with death; which was also agreeable to the old Gothic or Scandinavian constitution. Instead of this, another punishment was instituted by William the Conqueror, viz. castration and loss of eyes, which continued till after Bracton wrote in the reign of Henry III. But it was then the law, and still continues in appeals of rape, that the woman should immediately after go to the next town, and there make discovery to some credible persons of the injury she has suffered; and afterwards should acquaint the high constable of the hundred, the coroners and the sheriff, with the outrage; the time of limitation for this purpose was by stat. Westm. 1. cap. 13. extended to forty days. But there is now no time fixed; for as it is now usually punished by indictment at the suit of the king, the maxim of law takes place, *nullum tempus occurrit regi*: however, the jury will rarely give credit to a stale complaint. During the former period it was also held for law, that the woman (by consent of the judge and her parents) might redeem the offender from the execution of his sentence, by accepting him for her husband, if he also was willing to agree to the exchange, but not otherwise.

In the 3 Edw. 1. by the stat. Westm. 1. cap. 13. the punishment of rape was much mitigated: the offence being reduced to a trespass; if not prosecuted by the woman within forty days; and subjecting the offender only to two years imprisonment, and a fine at the king's will. But in the 13 Edw. 1. it was found necessary to make the offence of rape felony, by stat. Westm. 2. cap. 34. And by 18 Eliz. cap. 7. it was made felony without benefit of clergy; as is also the abominable wickedness of carnally knowing or abusing any woman-child, under the age of ten years; in which case the consent or non-consent is immaterial, as, by reason of her tender years, she is incapable of judgment and discretion. Sir Matthew Hale is indeed of opinion, that such profligate actions committed on an infant under the age of twelve years, the age of female discretion by the common law, either with or without consent, amount to rape and felony, as well since, as before the statute of queen Elizabeth; but the law has in general been held only to extend to infants under ten. A male infant, under the age of fourteen years, is presumed by law incapable of committing a rape; and, therefore, cannot be found guilty of it.

The civil law seems to suppose a prostitute incapable of any injuries of this kind; not allowing any punishment for violating the chastity of her who hath indeed no chastity at all, or at least hath no regard to it. But the law of England holds it to be felony to force even a concubine or harlot;

because the woman may have forsaken that unlawful course of life.

As to the material facts requisite to be given in evidence and proved upon an indictment of rape, we shall here only observe, that the party ravished may give evidence upon oath, and is in law a competent witness; but the credibility of her testimony must be left to the jury, upon the circumstances of fact that concur in that testimony: *e. gr.* if the witness be of good fame; if she presently discovered the offence and made search for the offender; if the party accused fled for it; these and the like are concurring circumstances, which give greater probability to her evidence. But, on the other side, if she be of evil fame, and stands unsupported by others; if she concealed the injury for any considerable time after she had opportunity to complain; if the place, where the fact was alleged to be committed, was where it was possible she might have been heard, and she made no outcry; these and the like circumstances carry a strong, but not conclusive, presumption, that her testimony is false or feigned. Moreover, if the rape be charged to be committed on an infant under twelve years of age, she may still be a competent witness, if she hath sense and understanding to know the nature and obligation of an oath; and, even if she hath not, it is thought by Sir Matthew Hale that she ought to be heard, without oath, to give the court information; though that alone will not be sufficient to convict the offender. And, indeed, it is now settled, that infants of any age are to be heard; and if they have any idea of an oath, to be also sworn: it being found by experience, that infants of very tender years often give the clearest and truest testimony. Blackitt. Com. book iv.

The civilians make another kind of rape, called *subornatio, rape of subornation, or seduction*; which is, when a person seduces or entices a maid to uncleanness, or even marriage, and that by gentle means; provided there be a considerable disparity in age or condition between the parties. In this case, the father and mother intend their action reciprocally for the *crimen raptus, or subornationis*.

The French laws make no difference between the rape of violence and that of solicitation, or subornation; they make both capital. This kind of rape our laws call *Ravishment*; which see.

RAPE of the Forest, is a trespass committed in the forest by violence.

This is mentioned in the laws of Henry I. as one of the crimes cognizable alone by the king.

RAPE is also a name given to the wood or stalks of the clusters of grapes, when dried, and freed from the fruit.

The rape is used in making vinegar, serving to heat and four the wine: but it is first put into a place to sour itself, before it be cast into the vinegar vessel; to which end, presently after the vintage, it is carefully put up in barrels, lest it take air, otherwise it would heat itself and be spoiled. There is no other way of keeping rape hitherto discovered, but to fill the vessel, in which it is contained, with wine or vinegar.

RAPE, Rapæ, is also used for a part or division of a county; signifying as much as a *hundred*.

Though sometimes rape is taken for a division containing several hundreds. Thus Suffex is divided into six rapes, viz. those of Chichester, Arundel, Bramber, Lewes, Pevensey, and Hastings: every one of which, besides its hundreds, has a castle, a river, and forest belonging to it.

The like parts in other counties are called *tithings, lathes, or wapentakes*.

RAPE, in Botany. See *NAPUS*.

RAPE, Broom. (See *OROBANCHÆ*.) It frequently grows

to the roots of genista or broom, whence it is called *rapum geniste*, or broom rape: it is also found among corn. The herb preserved, or its syrup, is said to be of excellent use in splenetic or hypochondriac disorders, and an ointment prepared of it with swine's fat, is good for hard and scirrhous tumours.

RAPE, Wild. See **MUSTARD.**

RAPE, in *Gardening*, the common name of a plant of the cabbage kind. The variety called the French turnip, or *Brassica napus*, has been long cultivated upon the continent, and preferred to the common turnip as a culinary vegetable. And it has been lately noticed in the "Transactions of the Horticultural Society," that it has been brought to the principal London markets for more than twelve years past by one person only, and sold chiefly to foreigners, though, when once fully known, it will be found a very useful and acceptable root in most families, as being more delicate in its flavour than the common turnip. It is used in much the same manner. It enriches soups, and there is not any necessity for cutting away the outer skin or rind, but only to scrape it, as it is a great deal thinner than that of the turnip. When stewed with gravy it forms an excellent dish, and being white and shaped like the carrot, when laid alternately with those on a dish, they become very ornamental. The French dress them somewhat in this manner.

The roots are to be washed quite clean by means of a brush; then scraped, cutting a thin slice away from the top and bottom parts, so as to make them all of equal lengths: after which boil them in water, with a little salt, until they are tender; then put them into a stew pan, with a gill of veal gravy, two spoonsful of lemon pickle, one of mushroom ketchup, a little mace, and salt, letting them just simmer, but by no means boil, for a quarter of an hour; afterwards thicken the gravy with flour and butter, serving the whole up quite hot. Some add a few spoonfuls of cream mixed with yolk of egg to this, just before dishing up; and others dress them in a similar manner to the above, sliced rather thinly, with Madeira, or other wines, after they have been fried to a brownish colour. See **BRASSICA.**

RAPE, in *Agriculture*, the name of a plant much cultivated for its seed, and also as a green food for cattle and sheep. The methods of culture and management that are necessary in raising crops of this sort, have been already described and explained. (See **COLE.**) It may, however, be here necessary to detail a few of the experiments that were made under the direction of the Dublin Society, by Mr. Whyn Baker, about the years 1769 and 1770, as they tend to throw additional light on the nature of the plant, as well as its cultivation, though the soil was not the most suitable for it. It was a shallow soil, of a strong adhesive nature when wet, and when perfectly dry, in lumps, almost impregnable; but between wet and dry, reducible. It lies upon a bed of lime-stone quarry, and has a natural declivity to the north-west; naturally very poor, and, he believes, never received any manure until he dressed it. Three acres of this land were, in 1768, under potatoes, in the ordinary method of the country, in seven-foot beds, and four-foot trenches. In 1769 they were under drilled turnips.

The frost, snow, hail, and rain which they had this year in the months of March and April, rendered it impossible to get the ground in any tolerable condition for the rape-seed before the 28th day of April. On that day twenty

broad sets were sown, with twelve ounces of rape-seed to each set or ridge. He intended to have sown it earlier, but the event will shew, that, as it was, he sowed it too early, at least upon this ground.

It was slow in coming up, and made but a poor figure until July. After which it shot forward; but instead of affording a plentiful mowing crop for the purpose of foddering cattle, it soon began to run up very fast, broke out into branches, with few and small leaves, like rape in blossom from the autumn sowing, but with strong branches and few leaves; and, in a short time after, began to grow hard, pipey, and the seed to form.

It September he began to mow it for cattle, and they ate it with great eagerness, but every day it became worse, by growing harder; inasmuch, that before it was exhausted there was very great waste, as to the object of fodder, but it wonderfully raised the dung-hill, which, in his mind, is of the first moment to the farmer: for if he has manure in plenty, and disposes of it judiciously, there is hardly any thing he need to fear, except climate.

It was pretty far in October before all his rape was cut, (and the seed coming forward very fast,) although it was brought home in great profusion. It was so strong, that the mowing of it could not be accomplished with a common scythe; it would have broken an hundred; but he had by him a short strong scythe, with a thick back, intended to mow bushes and other rubbish; with this instrument he got it mowed, but not so close to the ground as he wished, it being next to impossible to mow such strong plants as these were close to the ground; and he became the less solicitous about it, as from the strength of the rape stumps and roots, and the weeds which were upon the ground, owing to the rape shooting up in tall stems, he gave up his intention of sowing the ground with wheat, as was originally intended. Hence he concludes, that the rape was sown much too early.

On the 16th of July he transplanted some of this rape in rows upon ridges four feet wide; these plants flourished much better than the former, and were at least four times the size of any of those left in the ground where they were sown. Nevertheless, these also ran to seed; but the cold nights coming on prevented their forming their seed like the former. They were vastly more sappy, and much better food for cattle.

On the 24th of July, he drilled rape-seed upon the same ground.

Nº 1. Six ridges four feet wide, and thirty-two perches long in single rows.

Nº 2. Six ridges the same length and breadth, in double rows, ten inches asunder.

It is observed, that the double and single rows were drilled alternately on the same ground, on the 18th day of July.

Nº 3. Six ridges four feet wide, and thirty-two perches long, drilled in single rows.

Nº 4. Six ridges the same length and breadth, in double rows, ten inches asunder.

He remarks, that these were sown in alternate rows, on the same ground, on the 24th of July. And that the several rows were thinned the latter end of August, and twice horse-hoed during the summer. On the third of April 1771, he had a row of each of these cut and weighed, and the produce was as follows:

Rows.	Weight.					Prod. p. Plant. acre.			
	ton.	cwt.	qr.	lb.		t n.	cwt.	qr.	lb.
Nº 1. Single row produced	-	-	-	-	Sown July 18th	{ 29	6	1	16
2. Double row ditto	-	-	-	-		{ 32	12	2	23
3. Single row ditto	-	-	-	-		{ 33	14	1	26
4. Double row ditto	-	-	-	-	Sown July 24th	{ 34	18	0	6

On the whole, it is stated, that the last sowing in July afforded considerably greater produce than the first, for the plainest reason, that the earlier we sow this seed, the sooner it runs; and consequently affords the less produce for the purpose of foddering cattle in the yards for making dung, and seems to account very strongly for the state of the first experiment.

And the double rows produced uniformly more than the single rows; and indicate that the double are to be preferred in drilling rape for foddering cattle.

The following trials are on sowing rape-seed broad-cast. On the 24th of July two acres were sown broad-cast, with ten pounds of seed to each acre, in the same field where the other experiments were carried on; but the soil not so stiff by a good deal, has abundantly fewer loose stones in it, is very shallow, and poor, to an incapability of producing any thing to profit, without great assistance of manure.

In July he manured it with the dung of his yard, consisting of that of horned cattle, horses, and swine. The dressing was indeed very high; about two smart one-horse cart-loads to a perch. He having ever found that one acre, highly improved, is much more valuable than five imperfectly handled, was the reason why he gave this poor piece so liberal a dressing.

The rape came up but slowly for a time, as he finds to be the nature of the plant, but at length it shot forward, and flourished away: but in winter it met with a fate which he was not aware of, nor did he expect. The wood-pigeons lay upon it prodigiously, and did it great damage. Some plants he observed in the frost to appear as if they had been singed: whether that was owing to the wounds given by the birds, and thereby giving the frost the greater force, or whether it was owing entirely to the severity of the frost, is not in his power to determine. However, very early in the spring this rape shot forward, and as the days lengthened the visits of the pigeons were less frequent, until they totally left it.

From this rape breaking out into blossom sooner than he expected, he is inclined to believe that the 24th of July is too early to sow it for the purpose of foddering cattle in the yard.

However, early in April he began to mow this rape for the horned cattle, such as cows, plough bullocks, young cattle, calves, and swine. They all ate it with the greatest eagerness, and were foddered with it every evening, until the 19th of May inclusive, and wheat straw in a morning, save four calves of the preceding year; and they were foddered twice a day with rape, and had straw before them also, and thrived upon it vastly better than the other cattle; for no other reason, he believes, than because they were allowed more than the others: in short, they were in such order, that he dares believe the butchers would have been glad to have had them for killing.

He observes, that he need not tell the farmer how necessary it is to be frugal of provender in an harsh dry spring, as the last was, when he was like to be hard run with forty head of cattle, many of which he should actually have been obliged to sell at so improper a season, had he not been possessed of these two acres of rape. He adds, that there is yet another circumstance which renders this a truly valuable fodder. The milk of the cows increased prodigiously; and the milk and butter were as good, sweet, and well-flavoured, he thinks, in every particular, as ever he tasted in June. Even the cream for the tea appeared to be perfectly free from any foreign flavour. The cows got hay every day, in the same manner as he has in former years mentioned them to have, when feeding upon cabbages.

The simplicity of the culture for rape, for the purpose of feeding cattle, he cannot but think a particular recommendation to the farmer, and the cheapness of the feed in purchase, or the ease with which he may raise it, are objects which cannot fail, he thinks, of being persuasive to him. And all persons, who have annexed to their farms any bog, or other waste ground, the improvement of which can be executed by burning, might surely raise such quantities of rape for the purpose of mowing pasture, as would enable them to keep almost any number of cattle; by which they would not only be bringing in the waste land, but making that the foundation of improvement to their sound land, by the immense quantities of dung they might raise by this means from the waste land. Here the advantage to the cultivator would be double.

On the first day of May he had four perches of this rape measured out for weighing. It was mowed, immediately drawn home, and weighed. The four perches afforded seven hundred and two quarters: multiplying this by forty, shews the acreable produce to be fifteen tons. The quantity indeed but small. However, the season in which it is to be had renders it more than ordinarily valuable, and, he thinks, bids fair to make it an object of husbandry, as a pasture for cattle.

This year, 1770, Mr. Baker ploughed up six acres of wheat stubble, as soon as the wheat came off, harrowed it down the 12th, 13th, 14th, and 15th of September, then sowed rape-seed over the whole field, and gave it a light bush harrowing. The rape came up very thin, and made so poor an appearance in the spring, that he ploughed up the field, and sowed spring corn. This is a strong indication that but little is to be expected from sowing rape upon wheat stubble; because after the wheat comes off it seems to be too late in the year to sow rape. But something may be charged, as he observes, to the natural moisture of the soil. See COLE.

The following is the recapitulation of his experiments on rape, as pasture for cattle.

Exp.						Produce.			
						Ton.	cwt.	qr.	lb.
I.	April sowing.	Ran, not answering the purpose.							
II.	Ditto transplanted.	Ran, but not so soon as the other.							
III.	July 18, sowing.	{ Single rows produced <i>per</i> acre				29	6	1	16
		{ Double rows ditto				32	12	2	23
		{ Single rows ditto				34	14	1	26
		{ Double				35	18	0	9
IV.	Ditto	Broad-cast ditto	-	-	-	15	0	0	0
V.	September sowing on wheat stubble ditto	-	-	-	-	0	0	0	0

Rape is a great deal cultivated in some districts in the county of Essex for the feed. The system is very profitable, but this sort of crop is found to draw or exhaust the land a good deal. It is thought by some to prepare well for wheat, especially when fed off upon the land. In some places they, however, consider it more beneficial to till, after this crop

has been feeded for spring corn, than to put in wheat, which, however, is still the most common practice. Clover would certainly be better than either method.

In other places they conceive that feeding rape is much on the decline, from the general experience, that it leaves the best prepared land in an unfavourable state for oats and clover,

clover, and is consequently prejudicial to the next succeeding winter crop. Other districts think very differently on this point. In feeding the crop, the produce is here considered to be in general from twenty-nine to thirty-four bushels the acre. In the greatest crops and best seasons, in particular parts it is supposed to rise even so high as five and six quarters the acre.

In Berkshire this sort of crop is not so much cultivated as it should be, as it will succeed well on soil where turnips will not, and with equally beneficial effects to the future crops, when fed off on the ground. When employed it is usually sown and managed so as to come into a high state of perfection in the early spring months, when sheep feed is mostly scarce. It is grown by some to supply the deficiency, and found remarkably useful, one acre of it affording more feed than two of turnips.

This sort of crop is still less grown in Oxfordshire, though occasionally had recourse to, especially on the rich red land about Banbury. Some sow it in mixture with the tankard turnip feed, for the purpose of weaning lambs upon: they begin with the rape, and it teaches them to eat the turnips: it is found to be a very good food for this sort of stock.

In the county of Sussex, the South Down sheep farmers hold it in great estimation, sowing it either alone or in mixture with tares as a food for their sheep; very rarely for the purpose of feeding. The ewes and lambs are wattled upon it in the spring, and it is very generally allowed to be most efficacious, and highly nutritious to the young lambs. Some, at the lambing season, hardly allow their ewes any other food but this, as the rape is found to produce a larger supply of milk than turnips; which, it is supposed, has the effect of extending the udder, without affording any considerable flow of milk. This crop is conjectured, however, in some cases, to have the effect of causing the slipping of the lambs, where the ewes are fed upon it. But such an effect is very improbable to arise in this way; other causes may have been overlooked. In some cases on Down land ray-grass is sown with the rape for sheep feed, one gallon of rape-feed and two of ray-grass to the acre. The rape is first fed off; and after that the ray-grass rises and affords a bite for the spring season. The rape crop is usually put in about June, or the following month, one gallon to the acre. When folded off, a rood and a half is a sufficient daily consumption for a flock of six hundred sheep, or rather more.

As it has been found in the improving of peat boggy morass lands, that what is principally wanted is a crop which can be sown and reaped in the summer months; and which may require neither labour nor attendance during the moist seasons of autumn, winter, and spring; the writer of the "Treatise on Landed Property" has suggested that fortunately, such a crop is natural to, and has long been inured to the climate of this island, as well as one of the most profitable in the agriculture of it; and that this is rape: which is not only sown, but reaped, in the very height of summer; and which is known to delight in a soil of this nature. It has, however, only lately been found capable of being raised with advantage on crude mossy ground, as a first crop after draining, from some recent trials made in the north, after the above operation, levelling, paring and burning, and turning the ashes in. The result of which was, though the crop was too late in being put in, and the land laid in an improper manner, such as to prove clearly that rape-feed may be raised with profit as a first crop on drained moory soils. And it is thought highly probable that many extensive tracts of land, which now lie entirely waste, and as nuisances in their neighbourhoods, may through this means be improved with immense

profit to their proprietors. The experiment may be tried at a small expence. The cost of the labour and seed required for a sufficient trial are inconsiderable. The proof, it is supposed, is not whether rape will thrive as herbage, but whether it will mature its seed, on the given soil, in the given situation.

After being recompensed for the previous expences, in one or more rape crops, as there is here no danger of the exhaustion of the soil,—of impoverishing, perhaps, ten feet depth of vegetable mould, it remains to lay the foundation of more permanent profits, which is to be done by sowing grass seeds either with or over the rape crop, or by light cautious flocking after removing the stalks, as may be necessary, until there is a firmness of surface and a fitness for mixed cultivation, which may be much hastened by the use of heavy calcareous and earthy substances at any time during the process of improvement.

RAPE Cake, the refuse or cake remaining after the oil has been expressed from rape-feed. It is said to be useful as a manure. See **MANURE**.

This substance is found by chemical trials to contain a large quantity of mucilage, some albuminous matter, and a small quantity of oil. It should be kept as dry as possible before it is applied to the soil, and be employed in that way while it is in a fresh state. It is successfully applied in several ways and intentions, and affords an excellent dressing for turnips. See the next article.

RAPE Duff, the small reduced parts of the dried refuse of rape-feed, or the rape cake, after the oil has been obtained from it. This substance has been found useful as a top-dressing for crops of different kinds.

The rape cake, when reduced into powder or duff by means of a machine, has been extensively used in Norfolk; and when for turnip crops, it has been the custom to sow it some weeks before the seed of that root is put into the ground. In the practice of Mr. Coke of that district, it has, however, been found, that by having it brought into a fine powder it may be drilled from the same machine, at the same time with the turnip feed; and that, by thus delivering the manure and the seed from the same pipes and shares of the drill machine, a ton of duff does six acres in the place of three. See **TURNIP**.

In Lancashire some farmers use it with great advantage as a manure for potatoes, putting it in with the sets in the proportion of about thirty-two bushels to the statute acre; but if the ground were well prepared, and the duff carefully deposited for the reception of the sets, it is supposed, a much smaller quantity would be sufficient. It produces much luxuriance in the crops, and a very fine produce.

RAPE Oil, the oil obtained by means of expression from the seeds of this plant, in mills constructed for the purpose. The refuse oily substance of this kind may be employed as manure in mixture with rich earthy matters, with great advantage, wherever it can be procured in any quantity at a reasonable price.

RAPEL, in *Geography*, a river of Chili, which runs into the Pacific ocean, S. lat. 34° 8'.—Also, a town of Chili, on the forementioned river; 70 miles S. of Valparaiso.

RAPERLAH, a town of Hindoostan, in the Carnatic; 13 miles N.E. of Ongole.

RAPHA, in *Anatomy*. See **RAPHIE**.

RAPHAEL, one of the seven archangels, who are said to be continually before the throne of God, and ready to perform his commands. We have no such name in the Old

or New Testament; but his history occurs in the book of Tobit, c. xii.

If the story of Tobit be true, it is not improbable that the angels, both good and bad, whose names do not appear to have been known before the Babylonish captivity, are figurative personages; and Raphael might only denote the salutary protecting agency of divine providence, so disposing events as to produce a happy issue.

RAPHAEL SANZIO, DA URBINO, in *Biography*, during whose life, and by the exertion of whose talents, in conjunction with those of Lionardo da Vinci, Titian, Michael Angelo, and some few others, the art of painting reached its acme in modern times, was born in the city of Urbino, on the morning of Good Friday, in the year 1483. He was descended from a respectable family, and many of his ancestors had been painters; as was his father Giovanni Sanzio, whose talents, however, did not elevate him to the first rank. He cultivated with care the inclination which his son Raphael exhibited, at an early age, for painting; and was soon repaid by the assistance he acquired from him, in several of the pictures he was employed to paint in his native city of Urbino. But finding that the taste of Raphael merited more skilful guidance than he was able to give it, he placed him under the tuition of Corradini, better known by the name of Carnevale, for a short time, till he could be received as a pupil by Pietro Perugino, at Perugia.

This master was then in very high esteem, though his style was dry and meagre, in comparison with that of Masaccio, and others of the Florentine school. It is not surprising that Raphael, endowed as he was by nature, and trained as he had been in art, should soon become the rival, rather than the pupil, of such an artist. Accordingly we find, that his aptitude for the practice of art enabled him quickly to acquire his master's manner, and that in so perfect a degree, that connoisseurs were puzzled in their judgments upon the works which proceeded from Perugino's studio; and ordinary observers completely deceived. Vasari speaks of an Assumption of the Virgin, crowned by her Son, and the twelve apostles below, round her tomb, contemplating the celestial glories; with three small pictures in the same frame below it, of the Annunciation, the Adoration of the Magi, and Simon embracing the Saviour, painted at this period by Raphael, as being wrought with extreme beauty, and precisely like the work of Perugino.

We have to lament that we are left ignorant of the time when Raphael went as a pupil to Pietro, how long he remained with him, or when he left him, or rather was left by him; as that master returned to Florence, to finish some pictures he had begun there some time before. He must certainly have been very young, from the number of pictures which he subsequently executed, previous to his going to Rome in his 25th year, and probably not more than 16 or 17, when he acquired his liberty by the departure of Perugino.

From Perugia he went to Citta di Castello, where he painted a St. Nicola crowned by the Virgin and St. Augustine, for the church of St. Augustine; and for that of St. Domenico, a picture of the Crucifixion of Christ, accompanied by angels, the Virgin, St. John, &c.; which would certainly have been considered as Perugino's, if Raphael had not set his name to them. But he was considered to have much surpassed him in another work, representing the marriage of the Virgin and St. Francisco, for the church of St. Francisco, in the same city. He acquired by these productions a great and deserved extent of fame, and thus early

entered with success that course, which conducted him to the highest pinnacle of renown as an artist.

Attached to his person by friendship, and attracted by his skill as a designer, Pinturiccio, then employed by pope Pius II. to adorn the library of the Duomo at Sienna, sought the assistance of Raphael, and engaged him to compose designs for his work. This he undertook, but proceeded only to the preparation of some of the cartoons, when his ambition and his curiosity were stimulated, and his work interrupted, by the renown spread through the country of the cartoons painted by those great rivals, Lionardo da Vinci and M. Angelo, for the council-hall at Florence. He immediately determined, in conjunction with almost all his brother artists of the day, upon going to see and form his judgment upon them for himself; and consequently left his engagement with Pinturiccio, and proceeded to Florence.

In this city he found so many attractive beauties, both of nature and art, that he resolved to fix his residence there for some time. His agreeable person and manners, combined with the extraordinary talents he had manifested, insured him friends; and he became intimate with several artists of celebrity, among whom were Ghirlandaio, St. Gallo, and Taddeo Taddi; the latter of them, a learned man, and friend of cardinal Bembo, took the youthful painter to his house and table, and thus afforded him the best introduction to the world, while he pursued his more immediate studies. This kindness the gentle heart of Raphael accepted with grateful emotion; and as he painted several pictures during his residence in that city, he presented two of them to Taddi. One of these pictures, a Madonna with the Child, and St. John bringing a little bird to him, the heirs of Taddi sold to the archduke Ferdinand Charles of Austria at a great price: the other is lost sight of. He also presented a picture to his friend Lorenzo Nasi, which afterwards found a place in the Medicean gallery, and a duplicate in that of the monastery of Valombrosa.

From Florence Raphael was recalled to Urbino, by the death of both his father and mother; and there, when he had arranged his private affairs, he was engaged by Giordano de Montefeltro, and several others, to paint religious subjects for the altars of their chapels: and among those he painted at this time, were the two little St. Georges, now in the gallery of the Louvre. These commissions he executed with great taste and delicacy; and Vasari, who enumerates them, more particularly speaks of one of Christ praying in the garden, painted for Francesco Maria, duke of Urbino, as being finished with all the neatness of a miniature. What is become of most of these pictures, it is not easy to ascertain; but it is a curious fact, that not one of them remains at this time to adorn the native city of this great artist.

Thence he returned to Perugia, and painted several pictures. For the church of the Frati de Servi, one of the Virgin, with St. John Baptist, and St. Nicholas. For that of St. Stevens, in the chapel of our Lady, he painted in fresco a picture of Christ in glory, with God the Father, surrounded by angels and six saints, three on each side. Upon this picture he wrote his name in large letters of gold, and very conspicuously, as if he himself was pleased with the performance of it. He also painted here a picture for the nuns of St. Antonio da Padua, of our Lady with the Infant upon her lap clothed, and near her St. Peter, St. Paul, Sta. Cecilia, and Sta. Catherina. The airs and attire of the two female heads were regarded as the most tasteful work of the time, wrought with the greatest degree of beauty and grace. Above the picture, in a semicircle, was represented

represented the Almighty Father; and at the foot of it, in three compartments, were the scenes of our Lord's sufferings, *viz.* his agony in the garden, carrying his cross, and dead upon the lap of the Virgin. It is not known what is become of the centre picture, or the uppermost compartment; the lower ones formed a part of the Orleans collection. The execution of these works was performed in a style much improved upon that of Perugino; with more breadth, more softness, and more freedom and variety of action; proving that he had not ill spent the time he had devoted at Florence to the study of the works of other painters. Hence we may date the commencement of what is termed his second manner, from his first visit to that city.

Soon after he had produced these works at Perugia, that zeal for cultivation, which always accompanies true genius, led him to determine upon again visiting Florence, at that time the emporium of science and of art. Though the native strength and purity of his mind were such as to conduct him, under favourable circumstances, to his future prominent station; yet he does not appear to have been so extraordinary and original an inventor in the art itself as M. Angelo, or his great predecessor and rival, Lionardo da Vinci. He knew how to take a hint of what was offered to his view, and to cultivate and improve it to his purpose; but it yet remains a problem, whether Raphael, alone, and without the leading aid of those great and original artists, would have ever seen the sublime of painting. His power may rather be said to have consisted in ability to employ the materials furnished by their invention, *viz.* the style of Michael Angelo, in form; and of Lionardo da Vinci, in chiaro-scuro and colour; in beautiful conceptions, illustrative of the character and passions of man; and in an admirable selection of subject, and mode of conveying it.

He himself appears to have been conscious of this; for we find him in the midst of honourable employment, leaving the prosecution of it, to study and improve himself by a constant observation of the works of other renowned artists, and again repairing to Florence, where alone he could find the true source of sound cultivation, and in which he made so good use of his time, as to fit him in great measure for the glorious field of exertion which awaited him.

On his return to the renowned abode of these great artists, from whose works he sought improvement, he had a letter of recommendation and introduction from the dukes of Urbino to Pietro Soderini Gonfaloniere of the city; and was thus introduced to the best circle of improvement and information.

It would have been highly gratifying to have been enabled to trace the steps of a man so distinguished in the art, from the earliest commencement of his studies; but the neglect of dates, by his historians, counteracts every wish to follow them more closely; and the record of facts leaves us only the means of conjecture. That he began to paint original pictures very soon after he was placed with Perugino is evident, and he must then have been very young, for it is on record, that the pictures by Pinturicchio, for which he made the cartoons at Sienna, were completed in 1503, at which time he was 20. If we allow, as we reasonably may, two years for their execution, it will place his first visit to Florence in 1501, at the age of 18; and it certainly cannot have been far from that period. In every part of his life, modesty, ingenuity, and the ardour of a mind entirely devoted to his art, characterized his conduct. His industry and ingenuity seem to have kept equal pace; and the rapidity and certainty with which he must have painted, to

produce so many pictures in so short a space of time as he lived, are not the least extraordinary part of his history.

On this, his second abode at Florence, he studied deeply the works of Masaccio, and the cartoons of Angelo and Da Vinci; and attached himself in friendship to Baccio della Porta, better known by the name of Fra. Bartolomeo; than whom no one was better qualified to direct him rightly in whatever was grand and dignified, and from whose judicious information in the art of casting draperies and of colouring, Raphael evidently improved exceedingly; while he had the pleasure, in return, of communicating to his friend the principles of perspective. Yet notwithstanding these helps, he did not entirely free himself from the formal and dry manner of his master, though he painted assiduously both in portrait and history. In the former he produced the portraits of Angelo Doni and his lady Maddalena Strozzi; and in the latter he painted for Dominico Caneggiani, a Madonna, with the Infant playing with St. John brought by Elizabeth, who regards St. Joseph as he stands near, leaning both his hands upon a stick, and inclining his head towards her. This picture appears to have been re-touched, or possibly completed only in 1516, as the name of Raphael, with that date, in letters of gold, is written upon the drapery of the Virgin. He also made a cartoon during his residence in Florence for a picture which he had previously engaged to paint for the Baglioni family at Perugia, and left the city to go and paint it in the church of St. Francesco in that place. The subject of it was our Saviour carried to the sepulchre, accompanied by the Virgin, St. John, &c.; and it was exceedingly admired for the beauty and expression of the figures, and the skill and perfection of the draperies. This picture was removed from Perugia by pope Paul V., and a copy, by Cesare d'Arpino, placed in its stead: it afterwards found a station in the Borghese palace at Rome.

When Raphael had completed this work, he returned to renew his studies at Florence, and was employed by the family of Dei, to paint a picture for their altar in Santo Spirito, which he began, and conducted through the preparatory parts; and in the mean time painted another for the city of Sienna, of the Madonna in an open country, with the Child standing by her, and St. John kneeling before him, but was interrupted, in its execution, by a summons from pope Julius II. to Rome, and left it in the hands of his friend Ghirlandaio, to finish a piece of blue drapery which it wanted. This picture was afterwards sold to Francis, king of France, and is at present in the French collection, known by the name of the Belle Jardinière. The unfinished sketch of the picture begun for the Dei family, was bought, after the death of Raphael, from his heirs, by Baldassare Turini, and placed by him, in its original state, at the altar of his country church; it afterwards came into possession of the house of Buonvicini di Pescia, and was sold, by that family, to the grand duke Ferdinand, who, on removing it, placed a copy by Carlo Sacconi in its stead. This was done at night, and with the utmost secrecy, for fear of a disturbance among the populace, by whom it was highly prized.

Raphael was indebted for the high patronage of the pope, which placed him in the proper sphere for the exercise of talents such as he possessed, to the friendship of his relation Bramante d'Urbino the architect; and never was recommendation better supported by ability. Upon his arrival in Rome, in 1508, he was received with great courtesy by Julius, and the Camera della Segnatura, in the Vatican, assigned to him. He immediately began the preparation for his first picture, which was the School of Theology, better known by the name of the Dispute of the Sacrament, and in observing which, it is
worthy

worthy of remark how his mind enlarged, in regard to style in the art, as he became accustomed to consider largely of his work; and according to the field of employment which he found before him. The difference in style between one part of the picture, and that of the other, evidently points out where he began it; viz. on the right of the upper part, where the remains of the school of Perugino appears, and is spread through the centre, where the glory which surrounds our Saviour is represented in the Gothic manner, by rays of gold. As he proceeded, his style enlarged, and the lower part of the picture exhibits an immense improvement, and is almost equal to any of his subsequent productions.

In the same room are the pictures of the School of Athens, the Parnassus, painted in 1512, (where, surrounding Apollo and the Muses, he has introduced portraits of the great poets, both of antiquity and of his own time,) and the Jurisprudence, comprizing two subjects, one of the emperor Justinian delivering the digest of his code of laws to Tribonius, and another of pope Gregory IV. giving the decretal to a member of the consistory. Over each of these subjects, respectively, are painted circular ones of single figures, representing Theology, Philosophy, Poetry, and Justice.

When pope Julius saw the superior taste and talent with which Raphael produced the former of these works, he immediately ordered the whole of the stanze, or chambers, which it was intended to decorate, to be entrusted to him; and all that had previously been done by Perugino, Pietro del Borgo, Il Soddoma, and Bramante di Milano, to be removed. But of this order Raphael made only a partial use; preserving entire the work of his first master, and, partially, the ornamental labours of Il Soddoma.

While he was engaged upon these great works, he was not altogether indifferent to the more agreeable exercise of the pencil, and he painted for the church of the Augustines, the pictures of the prophet Isaiah, and the Sibyls who are supposed to have predicted the coming of Christ. He also painted the portrait of his great patron, Julius, now in the Louvre, and several smaller easel pictures of Madonnas, and other religious subjects. By these labours he acquired the renown they so well merited, and his manners appear to have been in perfect accordance with the beauties of his mind. His person also was handsome, and he was beloved, esteemed, and admired. Yet he continued to study, and to improve his talents, employing persons to collect specimens and make drawings from Grecian remains. Full of taste and feeling, he spared no pains to perfect his powers by a thorough knowledge of all that had been done in art, both ancient and modern. In consequence, however, the fact, related by Vasari, may be doubted, of his being admitted, while Michael Angelo was absent, to see the work of that great artist in the chapel of Sixtus IV.; the taste in which he wrought became aggrandized, and similar to that introduced by M. Angelo. About this time he painted the Galatea for Agostini Ghigi, and the Madonna di Foligno, at the desire of Sigismondo Conti, secretary of pope Julius II., for the great altar of the church at Araceli, and which is now at the Louvre.

In another chamber of the Vatican he painted four other large pictures, the subjects of which are, the miracle of Bolsenna, when the officiating priest, who doubted of the real presence in the Eucharist, is offering up the host, and perceiving, with astonishment, that it distils drops of blood; the release of St. Peter from prison; the Heliodorus; and Attila arrested, in his journey to Rome, by a vision of St.

Peter and St. Paul; these were completed in 1512, 13, and 14.

In these pictures his great improvement in colouring and style is most evident, and he continued to carry it still further into practice in another room, for which also he had composed four other subjects, known as the Incendio del Borgo; the coronation of Charlemagne by Leo III.; the same pope defending his conduct to the same emperor; and the descent of the Saracens at the port of Ostia.

Whilst Raphael was engaged on the Heliodorus, his first great patron, Julius II., died; but fortunately for the arts, if not for the tiara, he was succeeded by another, Leo X., who was even more attached to them, and more fond of the renown arising from the cultivation of whatever adorns society. By him, therefore, Raphael was ardently encouraged to proceed with his labours, and he continued to make designs for other apartments, particularly for the great hall of Constantine, as it is now called; but he did not live to execute them. The Incendio del Borgo was the last upon which he himself wrought; the rest were completed by Julio Romano. He was also employed by Leo to make the cartoons now at Hampton Court, as exemplars for works in tapestry, to be executed in Flanders, and which were completed at the expence of 70,000 crowns. Fortunately for us the originals were never returned to Rome, and were purchased afterwards by Charles I.

Upon the death of Bramante, in 1514, the superintendence of the architectural concerns of the Vatican was entrusted to Raphael, who had already exhibited his knowledge and taste in that art, by the introduction he had made of it in his pictures. He invented and began a palace for himself, and made several designs for others.

Notwithstanding the immense application necessary for the invention and completion of these important labours, together with the designs he composed for the ornamental parts, and the scriptural subjects on the ceilings and the coverings of the loggia and stanze of the Vatican, he found time to execute in fresco the designs which adorn the palace of Agostino Ghigi; the capital portrait of his great friend Leo X., with the cardinals de Medici and Rossi, now in the Louvre; the St. Michael, and the vision of Ezekiel, both in the same grand dépôt; a Madonna, Child, and St. Anne, for Florence; and a large picture of Christ bearing his Cross, for the monastery of St. Maria della Spasimo, at Palermo. Of this picture it is reported, that being sent on shipboard to go to Sicily, the vessel was beaten from its course by a tempest, and the mariners lost; when it drifted to Genoa, and of course its preservation was attributed to the divine influence of this great work. The Genoese chose also to suppose that the hand of God had thus pointed out their city as the proper place for its residence; and would not relinquish it for a length of time, till the papal influence interfered, when it was consigned to its original destination. He also painted the picture of St. John, which adorned the Orleans collection; and last of all, the Transfiguration; which indeed he had not quite finished when the unrelenting hand of death set a period to his labours, and deprived the world of further benefit from his talents, when he had only attained an age at which most other men are but beginning to be useful.

The immediate cause of his death is allowed to have been brought on by too great an indulgence in gallantry, and, Vasari adds, by mismanagement of his physicians, who bled him when they ought to have administered restoratives. On his death bed he made his will, leaving his favourite pupils, Julio Romano and Il Fattore, his heirs, and ordering his burial

burial to take place in the Pantheon (the church of Santa Maria Rotunda), where a monument still remains to his honour. He died on the same day of the year on which he was born, Good Friday, in 1520, at the age of 37, deeply lamented by all who knew his value. His body lay for a while in state, in one of the rooms wherein he had displayed the powers of his mind, and he was honoured by a public funeral; his last produce, the Transfiguration, being carried before him in the procession: and, that Rome might not be deprived of so noble a memorial of this extraordinary man, it was placed by the cardinal de Medici in the church of St. Pietro a Montorio, instead of being sent to France, as was originally intended.

Mr. Fuseli, in his edition of Pilkington, has given so discriminating and just an idea of the peculiar excellencies of Raphael, that we shall conclude our history of him by quoting it. "The general opinion has placed Raphael at the head of his art, not because he possessed a decided superiority over every other painter in every branch, but because no other artist ever arrived at uniting with his own peculiar excellence all the other parts of the art in an equal degree with him.

"The drama, or in other words the representation of character in conflict with passion, was his sphere; to represent this, his invention in the choice of the moment, his composition in the arrangement of his actors, and his expression in the delineation of their emotions, were, and are, and perhaps will be unrivalled. And to this he added a style of design dictated by the subject itself, a colour suited to the subject, all the grace which propriety permitted, or sentiment suggested, and as much chiaro-scuro as was compatible with his supreme desire of perspicuity and evidence. It is therefore only when he forsook the drama, to make excursions into the pure epic or sublime, that his forms become inadequate, and were inferior to those of M. Angelo: it is only in subjects where colour from a vehicle becomes the ruling principle, that he is excelled by Titian; he yields to Correggio only in that grace and that chiaro-scuro which is less the minister of propriety and sentiment, than its charming abuse, or voluptuous excess; and which sacrifices to the eye what was claimed in vain by the mind.

"Michael Angelo appears to have had no infancy: if he had, we are not acquainted with it: his earliest works equal in principle and elements of style the vigorous offsprings of his virility: Raphael we see in his cradle, we hear him stammer: but propriety rocked the cradle, and character formed his lips. Even the trammels of Pietro Perugino, dry and fervile in his style of design, formal and gothic in his composition, he traced what was essential, and separated it from what was accidental, in figure and subject. The works of Lionardo, and the cartoon of Pifa, invigorated his eye, but it was the antique that completed the system which he had begun to establish on nature. From the antique he learned discrimination and propriety of form. He found that in the construction of the body, the articulation of the bones was the true cause of ease and grace in the action of the limbs, and that the knowledge of this was the true cause of the superiority of the antients. He discovered that certain features were fitted for certain expressions, and peculiar to certain characters: that such a head, such hands, and such feet, are the stamens or the growth of such a body, and on physiognomy established uniformity of parts. When he designed, his attention was immediately directed to the primary intention and motive of his figure, next to its general measure, then to the bones and their articulation, from them to the principal muscles or those eminently wanted, to their attendant nerves, and at last to the more or less essential

minutiae; but the character part of the subject is infallibly the characteristic part of his design, whether it be a rapid sketch, or a more finished drawing. The strokes of his pen or pencil themselves are characteristic: they follow the direction and texture of the part; flesh in their rounding, tendons in straight, bones in angular lines.

"Such was the felicity and propriety of Raphael, when employed in the dramatic evolutions of character! both suffered when he attempted to abstract the forms of sublimity and beauty; the painter of humanity, not often wielded with success super-human weapons. His gods never rose above prophetic or patriarchal forms; if the finger of Michael Angelo impressed the divine countenance oftener with sternness than awe, the gods of Raphael are sometimes too affable or mild, like him who speaks to Jacob, in a ceiling of the Vatican; or too violent, like him who separates light from darkness, in the loggia of the same place. But though, to speak with things, he was chiefly made to walk with dignity on earth, he soared above it in the conception of Christ on Tabor, and still more in the frown of the angelic countenance that withers the strength of Heliogorus.

"Of ideal female beauty, though he himself, in his letter to count Castiglione, tells us, that from its scarcity in life, he made attempts to reach it by an idea formed in his own mind, he certainly wanted that standard which guided him in character: his goddesses and mythologic females are no more than aggravations of the generic forms of Michael Angelo. When the drama inspired Raphael, his women became definitions of grace and pathos at once. Such is the exquisite line and turn of the half-averted kneeling female with two children, among the spectators of the punishment inflicted on Heliogorus; her attitude, the turn of her neck, supplies all face, and intimates more than he ever expressed by features."

RAPHAEL, in *Geography*, a fertile and healthy district, being the westernmost in the Spanish part of St. Domingo. Its northern boundary is found in part of the French parish Gonfaves. The air round St. Raphael is very salubrious, but the town, which is in a hollow, is very hot; 10 leagues S. of Cape François.

RAPHAEL, *St.*, *Cape*, lies at the S. end of St. Domingo, and is the S.E. limit of Samana bay.

RAPHANEA, in *Ancient Geography*, a city of Syria, between which and Arca, or Arac, a city of Judea belonging to the kingdom of Agrippa, the Sabbatical river flowed. Joseph. de Bell. l. vii. c. 24. Raphanea is, perhaps, the Arpal of scripture. 2 Kings, xviii. 34. xix. 13. II. x. 9. xxxvi. 19. xxxvii. 13. Jerem. xlix. 23.

RAPHANIA, in *Medicine*, an appellation given by Linnæus, and afterwards by Dr. Cullen and others, to a severe and fatal disease, which has been described as epidemic in Sweden at particular seasons, and imputed to the use of the *raphanus* raphanistrum of Linnæus as food.

It is not necessary to describe the symptoms of this disease in this place; since it is, in fact, the same malady which has been epidemic in various other countries of Europe, during seasons of scarcity; and has been attributed to various other species of unwholesome grain, but more especially to diseased rye, affected with the *ergot*, to the *lolium temulentum*, to charlock, &c. We have already entered at great length into the history of the symptoms and imputed causes of this formidable malady, which has been more commonly denominated *ergot*, from one of its supposed sources. (See *ERGOT*.) We have endeavoured also to shew, that it constituted one of the varieties of epidemic disease, described by the ancients, under the appellation of *lexis Sacer* (which see); and that, instead of being properly imputed to the

admixture of any of these substances with the corn used for food, the disease is to be ascribed with more probability to the insufficient nourishment afforded by damaged corn, or the actual dearth of it, which usually occur together; especially as these diseases have commonly been epidemic in years of scarcity, which is the only circumstance that can be observed in common to all the epidemics described by authors. In addition to the works on ergot and ignis sacer, formerly referred to, consult, for an account of raphania, Pulteney's View of the Writings of Linnæus; Rothman's Paper, in the *Amœnitates Academ. of Sweden*; Tissot, *Epistole Med. Pract.*

RAPHANIS, in *Botany*, the name by which the Attics, among the Greeks, called the radish; for the word *raphanos*, or *raphanus*, with them, does not express the radish, but the cabbage. The Greek of all other places concurred in calling the radish *raphanos*, and the cabbage *crambe*; and it is owing to this that we have many authors who confound together these two plants, though so very unlike one another in appearance and use. It is generally to be understood, that wherever Theophrastus mentions the word *raphanos*, he means by it the cabbage; and the same being observed, in regard to all the other Attic writers, the whole danger of confusion and error will cease.

RAPHANISTRUM, a name given by botanists to the wild radish, and designed to express its affinity to the cultivated one. See **RAPHANUS**.

RAPHANUS, an ancient name for the Radish, a species of this genus, derived from *ῥα, easily*, or *quickly*, and *εἰσέρχαι, to appear*, or *come forth*, in allusion to the quickness of its vegetation.—Linn. Gen. 343. Schreb. 445. Willd. Sp. Pl. v. 3. 560. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 4. 129. Sm. Fl. Brit. 723. Prodr. Fl. Græc. Sibth. v. 2. 32. Juss. 238. Tourn. t. 114. Lamarec Illustr. t. 566. Gærtn. t. 143. (*Raphanistrum*; Tourn. t. 115. Gærtn. t. 143.)—Class and order, *Tetradynamia Siliquosa*. Nat. Ord. *Siliquosæ*, Linn. *Crucifera*, Juss.

Gen. Ch. *Cal.* Perianth inferior, erect, of four oblong, parallel, converging, deciduous leaves, gibbous at the base. *Cor.* cruciform, of four inversely heart-shaped, spreading petals, whose claws are rather longer than the calyx. Nectariferous glands four; one at each side, between the shorter stamen and the pistil; and one at each of the opposite sides between the longer stamens and the calyx. *Stam.* Filaments six, awl-shaped, erect; two opposite ones the length of the calyx; the rest as long as the claws of the corolla; anthers simple. *Pist.* Germen oblong, tumid, tapering, the length of the stamens; style scarcely any; stigma capitate, undivided. *Peric.* Pod oblong, pointed, swelling here and there, imperfectly jointed, without valves. *Seeds* roundish, smooth.

Obf. *Raphanus* of Tournefort and Gærtner has a spongy fruit, of two cells, not burbling. *Raphanistrum* of the same authors has a jointed fruit, separating at the joints.

Efl. Ch. Calyx closed. Nectariferous glands four. Pod swelling out into knobs, imperfectly jointed, without valves.

1. *R. sativus*. Common Garden Radish. Linn. Sp. Pl. 935. Willd. n. 1. Ait. n. 1. Ger. Em. 237. (*R. primus*; Matth. Valgr. v. 1. 399.)—Leaves lyrate. Pod roundish, tumid, of two cells.—The native country of this well-known plant, so commonly cultivated in gardens, is not ascertained. Linnæus mentions China; but his authority does not appear. Its chief value with us consists in the root, esteemed for its grateful pungency, mixed with a watery coolness. The shape of this part varies, from its natural spindle-like figure, to a globular one, and the colour

of the skin from purple to white. We doubt much whether the *R. niger* of Bauhin, commonly called the Black Spanish Radish, which Linnæus marks β , can belong to this species. Its firmness, and black rugged coat, seem to indicate more than a mere variety. We have not examined the herbage. The leaves of *R. sativus* are lyrate, notched, and rough, especially the lower ones; the upper part of the herb is smoother, and somewhat glaucous. Stem branched. Flowers purple, corymbose; soon racemose. Pods erect, tumid, juicy, pale, glaucous, smooth, slightly striated, various in length and thickness, tipped with an awl-shaped beak. Linnæus cultivated at Upsal a Chinese variety, or possibly species, whose leaves are broader and smoother, and its whole habit more lax. The oil of the seeds is said to be used in China.

2. *R. caudatus*. Long-tailed Radish. Linn. Mant. 95. Linn. fil. Plant. Rar. fasc. 1. 19. t. 10. Willd. n. 2.—Leaves lyrate. Pod compressed, of one cell, wavy, longer than the whole plant.—Native of Java, where, according to the younger Linnæus, it is cultivated, and the pickled pods known by the name of Mougri. In Sweden, as well as in England, it may be treated as a hardy annual, like the foregoing; but the present species does not occur in Hort. Kew., though Mr. Lambert met with it last year in a country garden in Wiltshire. The appearance of the plant, weighed down to the ground by its immoderately long serpentine pods, is altogether extraordinary. The lobes and indentations of the leaves are sharper than in the Common Radish, but the flowers and other parts, except the pods, scarcely betray any difference.

3. *R. Raphanistrum*. Wild Radish, or Jointed Charlock. Linn. Sp. Pl. 935. Willd. n. 3. Ait. n. 2. Fl. Brit. n. 1. α , β . Eng. Bot. t. 856. Curt. Lond. fasc. 4. t. 46. Mart. Rust. t. 71. Fl. Dan. t. 678. (*R. sylvestris*; Ger. Em. 240.)—Leaves simply lyrate. Pod round, jointed, even, of one cell.—A troublesome weed in the corn-fields of Europe, flowering in June and July. The root is annual, small, and tapering. Stem branched, round, glaucous, rough with prominent bristles, leafy. Leaves rough, lyrate; the upper ones oblong, simply toothed. Flowers numerous, lemon-coloured, changing to white in decay, with purple veins; sometimes the petals are white from the first. Pods cylindrical, or rather tapering, beaked, knobbed or imperfectly jointed, smooth, becoming striated as they ripen. In a young state they are divided into two cells, but the partition is obliterated, and confounded in one spongy mass, as they ripen. Linnæus was of opinion that the seeds of this plant caused a convulsive disease, thence termed by him *Raphania*, of which he has given a history in *Amœn. Acad.* v. 6. 430, with a figure, and elaborate synonymy of the plant. We have never met with any circumstance to corroborate this hypothesis.

4. *R. maritimus*. Sea Radish. Sm. Engl. Bot. t. 1643. Ait. n. 3. (*R. Raphanistrum* γ ; Fl. Brit. 723. *R. maritimus*, flore luteo, siliquis articulatis, secundum longitudinem eminentè striatis; Raii Syn. 296. *Raphanistrum siliquâ articulata striatâ maximâ*; Moris. v. 2. 266. Raii Hist. v. 1. 806.)—Radical leaves interruptedly lyrate. Pod round, jointed, smooth, deeply furrowed, of one cell.—Found on the sea-shore in various parts of Britain, flowering in May. The late Rev. Dr. Walker, and Mr. J. Mackay, observed it on the western coasts of Scotland; and the former cultivated this plant, till his death, as an esculent root, preferable to horse radish; he also found that cattle were very fond of the leaves. Mr. Turner and Mr. W. Borrer gathered the same on rocks, near Beachy Head, Suffex. The root is large and succulent, lasting two or three

three years. *Stems* three or four feet high, round, roughest at the base. *Leaves* all rough, and rather sharply toothed; the radical ones interruptedly lyrate, which we have never observed in the last described species. *Flowers* of a deeper yellow, and less veiny. *Pods* strongly jointed, and very deeply furrowed longitudinally, destitute of hairs or other roughness. There can be no doubt of this being a distinct species from the former, though generally confounded therewith.

5. *R. fibricus*. Siberian Radish. Linn. Sp. Pl. 935. Murray Comment. Gott. for 1775. 48. t. 11. (R. n. 28; Gmel. Sib. v. 3. 266.)—*Leaves* pinnatifid, somewhat toothed. *Pod* round, beaded, downy, of one cell.—Native of Siberia. The seeds were sent by Professor Pallas to the Goettingen garden, where the plant flowered in June. *Root* annual, long, and slender. *Stems* from three to six inches high; or more, as the seeds ripen, ascending, leafy, hairy, simple or branched. *Leaves* sometimes elegantly and neatly pinnatifid, almost pectinate, either in a simple or interrupted manner, roughish at the edge only, sometimes more dilated, with distant and broader lobes. *Flowers* large, yellow, sweet-scented in an evening, their *petals* strongly emarginate. *Pods* inflexed, copiously and neatly beaded in appearance, rather than distinctly jointed, downy, each with a sharp taper beak.

6. *R. tenellus*. Slender Purple Radish. Pallas Trav. v. 3. append. 741. t. L. f. 3. Willd. n. 5. Ehrh. Sel. n. 38. (*Chorispermum tenellum*; Brown in Ait. H. Kew. v. 4. 129.)—*Leaves* smooth, oblong, toothed; the lowermost pinnatifid. *Pod* awl-shaped, jointed, smooth, of two cells.—Native of deserts near the Caspian sea. A hardy annual in our gardens, flowering in June and July. *Root* long, simple, tapering, and slender. *Herb* smooth, scarcely branched, leafy. *Leaves* elliptic-oblong, toothed or pinnatifid, tapering down into longish footstalks. *Flowers* small, purple. Beak of the *pod* very long and slender. The ingenious Mr. Brown separates this from *Raphanus* chiefly, as it seems, because the cotyledons are flat, not folded.

7. *R. arcuatus*. Curve-podded Radish. Willd. n. 6.—“*Leaves* oblong-lanceolate, toothed. *Pod* awl-shaped, curved, two-celled, smooth.”—Native country unknown. Willdenow cultivated the plant, which he describes as annual, with an erect branched *stem*, hardly a span high. *Leaves* stalked, oblong-lanceolate, very smooth, with broad shallow teeth. *Flowers* small, violet. *Pods* round, of two cells, jointed, curved, smooth, striated, with an awl-shaped beak. The figure of *Hesperis arenaria*, Desfont. Atlant. v. 2. t. 162, answers exactly to this plant, except the pods. Willdenow.

8. *R. lanceolatus*. Lanceolate Radish. Willd. n. 7.—“*Leaves* oblong-lanceolate, somewhat toothed at the apex. *Pod* tumid, smooth, two-celled, with a squarish beak.”—Native of the West Indies. *Stem* a foot and half high, erect, zigzag, with short branches, smooth like every other part of the plant. *Leaves* stalked, oblong-lanceolate; the uppermost lanceolate, narrow, entire; the lower ones bluntly toothed at the extremity. *Flowers* of a middling size, yellow, in a terminal cluster, six inches long. *Pods* half an inch long, with a long, obtuse, obscurely quadrangular beak. Willdenow.

9. *R. pilosus*. Hairy-stalked Radish. Willd. n. 8.—“*Leaves* lanceolate-linear, pinnatifid at the base. *Stem* rough with bristly hairs. *Pod* round, smooth, jointed, of one cell.”—Native of Guinea. *Stem* two feet, or perhaps more, in height, branched, divaricated. *Leaves* three inches long, narrow, smooth, pointed; pinnatifid at the base;

toothed in the middle; entire at the extremity. *Cluster*, axillary from every leaf, of few flowers. *Pods* an inch and half long, round, jointed, of one cell, with a short beak, all of them turned one way. Willdenow.

R. crucoides, Linn. Suppl. 299, is rightly referred by Mr. Brown, in Ait. H. Kew. v. 4. 126, to *Sinapis Althoffii*, Jacq. Hort. Vind. v. 2. t. 168. Willd. Sp. Pl. v. 3. 557. (See SINAPIS.) Willdenow cites it, doubtingly, under *Brassica Cheiranthus* of Villars, a very different plant; for which he also by mistake quotes Barrel. Ic. t. 1016, a synonym properly belonging to *Sisymbrium Barrelieri*.

Linnaeus once referred *Bunias Cakile* to this genus of *Raphanus*.

RAPHANUS, in Gardening, contains plants of the herbaceous, annual, esculent kind, of which the species cultivated is, the common garden radish (*R. sativus*).

There are several varieties; some of which have the appearance of distinct species, from their shape, size, and colour of the roots; as the *long-rooted*, which is that commonly cultivated in kitchen-gardens for its roots. Of this there are several subordinate variations: as the small-topped, and the long-topped striped radish. The small-topped is most commonly preferred by the gardeners near London, as they require much less room than those with large tops; for as forward radishes are what produce the greatest profit to the gardener, and these are commonly sown upon borders near hedges, walls, or pales, the large-topped sorts would be apt to grow mostly at top, and not swell so much in the root as the other, especially if the plants should be left pretty close.

The *small round-rooted*, which is not very common here, but in many parts of Italy it is the only one cultivated; the roots of this are very white, round, small, and very sweet. It is now frequently brought to the London markets in the spring, generally in bunches, and is sometimes mistaken there for young turnips: when eaten young, it is crisp, mild, and pleasant.

The large *turnip-rooted*, or *white Spanish*, which has a moderately large, spheroidal white root, and is esteemed chiefly for eating in autumn and the early part of winter. Both these sorts are commonly called indiscriminately turnip radishes.

The *black turnip-rooted Spanish*, which has a root like the preceding, white within, but with a black skin; and is greatly esteemed by many for autumn and winter eating.

There are likewise some other subvarieties of the radish noticed by gardeners, as the common *salmon radish*, and the short-topped early *salmon radish*. Also the small red *turnip-rooted radish*. Gardeners, too, often call the long-topped sort the *fallad radish*.

Method of Culture.—These are raised from seed by different sowings from the end of October till April, or the following month. They should have a light fine mould, and the more early sowings be made on borders, under warm walls, or other similar places, and in frames covered by glasses. The common spindle-rooted, short-topped sorts are mostly made use of in these early sowings, the seed being sown broadcast over the beds after they have been prepared by digging over and raking the surface even, being covered in with a slight raking. Some sow carrots with the early crops of radishes.

It is usual to protect the early sown crops in the borders, during frosty nights and bad weather, by mats or dry wheat straw, which should be carefully removed every mild day. By this means they are brought more forward, as well as form better roots. When mats are used, and supported by pegs or hoops, they are readily applied and removed.

A second more general sowing should be made in January or February. When the crops have got their rough leaf, they should be thinned out, where they are too thick, to the distance of two inches, as there will be constantly more thinning by the daily drawing of the young radishes.

When the weather is dry in March, or the following month, the crops should be occasionally well watered, which not only forwards the growth of the crops, but increases the size of the roots, and renders them more mild and crisp in eating.

And the sowings should be continued at the distance of a fortnight, till the latter end of March, when they should be performed every ten days, until the end of April or beginning of the following month. In sowing these later crops, it is the practice of some gardeners to sow cobs-lettuces and spinach with them, in order to have the two crops coming forward at the same time, but the practice is not to be much recommended, where there is sufficient room.

But in sowing the main general crops in the open quarters, the market-gardeners generally put them in on the same ground where they plant out their main crops of cauliflowers and cabbages, mixing spinach with the radish-seed as above, sowing the seeds first, and raking them in, then planting the cauliflowers or cabbages; the radishes and spinach come in for use before the other plants begin to spread much, and as soon as those small crops are all cleared off for use, hoe the ground all over to kill weeds and loosen the soil, drawing earth about the stems of the cauliflowers and cabbages.

The turnip radish should not be sown till the beginning of March, the plants being allowed a greater distance than for the common spindle-rooted sort. The seeds of this sort are apt to degenerate, unless they are set at a distance from that kind.

The white and black Spanish radishes are usually sown about the middle of July, or a little earlier, and are fit for the table by the end of August, or the beginning of September, continuing good till frost spoils them. These should be thinned to a greater distance than the common sort, as their roots grow as large as turnips, and should not be left nearer than six inches.

To have these roots in winter, they should be drawn before hard frost comes on, and laid in dry sand, as practised for carrots, carefully guarding them from wet and frost; as in this way they may be kept till the spring.

In regard to the culture of the general crops, they require very little, except occasional thinning where they are too thick, when the plants are come into the rough leaf, either by hoeing or drawing them out by hand: though for large quantities, small hoeing is the most expeditious mode of thinning, as well as most beneficial to the crop by loosening the ground; in either method thinning the plants to about two or three inches distance, clearing out the weakest, and leaving the strongest to form the crop.

In order to save the seed, about the beginning of May some ground should be prepared by digging and levelling; then drawing some of the straightest and best-coloured radishes, plant them in rows three feet distant, and two feet asunder in the rows; observing, if the season be dry, to water them until they have taken root: after which they will only require to have the weeds hoed down between them, until they are advanced so high as to overspread the ground.

When the seed begins to ripen, it should be carefully guarded against the birds. When it is ripe, the pods will turn brown: then it must be cut, and spread in the sun to dry; after which it must be thrashed, and laid up for use where no mice can come at it.

Method of Culture on Hot-beds.—This method is sometimes practised in order to have the roots early, as in January or the following month. They should have eighteen inches depth of dung to bring them up, and six or seven inches depth of light rich mould. The seed should be sown moderately thick, covering it in half an inch thick, and putting on the lights: the plants usually come up in a week or less; and when they appear, the lights should be lifted or taken off occasionally, according to the weather; and in a fortnight thin the plants to the distance of an inch and half or two inches, when in six weeks they will be fit to draw. Where there are no frames to spare, the beds may be covered with mats over hoops, and the sides secured by boards and straw-bands. And when in want of dung, if the beds be covered with frames, and the lights put on at night and in bad weather, the plants may be raised for use a fortnight sooner than in the open borders.

RAPHÉ, in *Anatomy*, a Greek term, signifying future, applied to some parts of the body; thus we have the raphe corporis callosi in the brain (see **BRAIN**); raphe perinei, scroti, and penis. See **GENERATION**.

RAPHELENGIUS, sometimes called **RAULENGHIEN**, **FRANCIS**, in *Biography*, a learned orientalist, was born in 1539 at Lanoy, near Lille, in Flanders. He had the early part of his education at Ghent, but on the death of his father, it was intended to bring him up to trade, and for that purpose he was sent to Nuremberg. Here he had access to books, resumed his studies, and took an opportunity of going to Paris, where he made great progress in the Greek and Hebrew languages. The civil wars obliged him to quit France, and he came to England, where, for some time, he taught Greek in the university of Cambridge. After this he returned to the Low Countries, and became a corrector of the press to the celebrated printer Plantin, whose daughter he married in the year 1565. He made himself very serviceable in the printing office, especially with respect to the famous Antwerp Polyglot Bible, printed in 1571 by order of Philip II. of Spain. When Plantin removed to Leyden, he left his business at Antwerp under the care of Raphelengius, and upon his return the latter went to Leyden. The curators of the university of that place conferred upon him the professorship of Hebrew, to which was added that of Arabic. He died in 1597. His literary works were "Variæ Lectiones et Emendationes in Chaldaicam Bibliorum Paraphrasin;" "Grammatica Hebræa;" "Dictionarium Chaldaicum;" and "Lexicon Arabicum." He had a son of the same name, a man of talents and learning, who published "Notes upon Seneca's Tragedies," and "Eulogies, in Verse, of fifty Persons, with their Portraits."

RAPHIA, in *Botany*, from *ῥαφή*, a point or needle, so that it ought to have been *Rhaphia*, a genus of Palms, with a very pointed fruit, established by Palisot Beauvois, in his *Flore d'Oware et de Benin*, fasc. 8.

RAPHIA, in *Ancient Geography*, a famous city in the Mediterranean, between Gaza and Rhinocorura. This was perhaps Gath of the Rephiam. Raphia is famous for the victory of Philopator, king of Egypt, over Antiochus the Great, king of Syria. (3 Maccab. i. 11.) Josephus says (Antiq. l. xiii. c. 21.) that Raphia was taken by Alexander Jannæus, and after being ruined in the wars, was repaired by Gabinius. There are extant some ancient medals struck at Raphia, and some bishops of this city are found in the lists of the eastern councils.

RAPHIDIA, in *Entomology*, a genus of insects of the order Neuroptera, of which there are two species. The generic character is as follows; Mouth with a curved toothed

toothed horny mandible; the thorax is long and cylindrical; it has three stigmata; the wings are deflected; the antennæ filiform, as long as the thorax, the anterior part is elongated and cylindrical: it has four feelers, which are short and filiform; the tail of the female is terminated by a large recurved bristle.

* OPHIOSUS. The wings of this species are immaculate. It inhabits divers parts of Europe in woods, and preys on other insects.

* NOTATA. Wings with a brown marginal spot. It inhabits England, and has been thought to be only a variety of the former. The body is black; the head is also black with a testaceous spot; the legs are testaceous; the appendage of the female is as long as the body.

RAPHOE, in *Geography*, a bishopric of Ireland, in the ecclesiastical province of Armagh, which comprises the greater part of the county of Donegal, being 44 miles in length from north to south, and 32 in breadth, comprehending 515,250 Irish acres. It contains 31 parishes, in which are 32 churches. The dean, archdeacon, and four prebendaries, compose the chapter. The patronage of 6 parishes, which form the corps of the deanery, is in the crown; of 15 others, in the bishop; of 7, in the university of Dublin; and of 3, in lay hands. It is not precisely known at what time this see was founded, but it must have been as early as the ninth century, since bishops of Raphoe are mentioned at that time. Beaufort.

RAPHOE, a small post-town of Ireland, the parish church of which serves as a cathedral, where is the bishop's palace. It is 107 miles N. by W. from Dublin.

RAPHOE, a township in Lancaster county, Pennsylvania, containing 2814 inhabitants.

RAPHON, in *Ancient Geography*, a city beyond Jordan, on a brook, not far from Carnaim.

RAPICIO, GROVITA, in *Biography*, an Italian man of letters, was born about the year 1480, at Chiari, in the territory of Brescia. Devoting himself to the instruction of youth in literature, he first opened a school at Bergamo, where he wrote a Latin treatise on the education of youth, which was afterwards printed at Venice. He next taught at Vicenza, and various other cities in Italy; and was for many years employed at Venice in instructing, in polite literature, the youths destined for public life, and among others, the care and instruction of the sons of cardinal Bembo were devolved upon him. Cardinal Pole, in one of his letters, speaks of Rapicio in high terms of commendation. He died at Venice in 1553. He was author of various harangues, poems, and epistles, but his chief work was entitled "De numero Oratorio," in five books, printed at Venice in 1544. "In this," says his biographer, "he minutely investigates the principles of writing the Latin language with sweetness and harmony, and he replies to Melancthon's assertion, that rules of this kind are rendered useless by our ignorance of the ancient pronunciation. Moreri."

RAPID ANN, in *Geography*, a small river of Virginia, which runs into the Rappahanock, about 10 miles above Fredericksburg.

RAPID Plat, *Ile au*, a small island of Upper Canada, in the river St. Lawrence, in front of the township of Matilda, containing about 200 acres.

RAPID River, a river which runs into Hudson's Bay.

RAPIDES, a county of the territory of Orleans, containing three parishes, viz. Rapides, including 2200 inhabitants, Catahula 1164, and Arvoelles 1209.

RAPIER, properly denotes a long, ordinary, old-

fashioned cutting sword, such as those worn by the common soldiers.

The word is formed from the French *rapiere*, of the Greek *ῥαπίς*, *cadere*, to smite, or strike.

In this sense do the French still use the term; so that among them, to *take the rapier*, is to enter in the army.

RAPIER, in a modern sense among us, usually denotes a small sword, as contradistinguished from a back-sword, or cutting-sword.

RAPILLO, in *Mineralogy*, the name given by the Italians to the sand or powders (improperly called ashes) thrown from the craters of volcanoes in immense quantities, towards the conclusion of an eruption. See VOLCANO, and VOLCANIC Products.

RAPIN, RENE, in *Biography*, a Jesuit, was born at Tours in 1621. He entered the society in 1639, and was a teacher of the belles lettres in it during nine years. He became eminent by several publications in the Latin and French, and obtained a high rank among the literary characters of his time. It is, however, as a Latin poet that he is chiefly known: his didactic poem on *Gardens*, entitled "Hortorum, lib. iv." first printed in 1665, has passed through many editions, and has been regarded as one of the most elegant and classical pieces of modern Latin verse. By others it has been thought a work of art and study, rather than an effusion of poetical feeling and fancy, and treats on gardening more as a branch of rural economy than as one of the fine arts. His other Latin poems are sacred eclogues, heroic, elegiac, and lyric poems. Father Rapin died at Paris in 1687. He was no less esteemed for his virtues and amiable qualities, than admired for his talents; and he possessed all that polish and fineness for the society of the great world, which have distinguished this order from other religious communities. His works were collected and published, in 3 vols. 12mo. 1681. There is a fine edition of his "Hortorum," published by Brotier at Paris, in 1780. Rapin was great as a critic, in which line he is known by his "Reflexions sur l'Eloquence, sur la Poësie, sur l'Histoire, et sur la Philosophie;" and also by his "Comparaïsons de Virgile et d'Homere," printed in 2 vols. 4to. Bayle. Moreri.

RAPIN DE THOYRAS, PAUL, well known as the historian of England, was born at Castres, in Languedoc, in 1661. He was descended from a noble family of Savoy, which came into France in the reign of Francis I. for the sake of professing the reformed religion. The subject of this article, after having received his education, went to his father, who was an advocate in the chamber of the edict at Nantes, for the purpose of studying the law. He was in due time admitted an advocate, but the chamber being suppressed in the same year, he went with his father to Toulouse. On the revocation of the edict of Nantes, in 1685, he withdrew to England, after which he went to Holland, and entered into a company of French cadets at Utrecht. In 1689 he followed the prince of Orange into England, and obtained an ensigncy in lord Kingstons's regiment, which went to Ireland. He was engaged in several battles, particularly at the sieges of Carrickfergus and Limerick, and at the battle of the Boyne, and so much distinguished himself, that he obtained a captain's commission. In 1693 he was nominated governor to the son of the earl of Portland, resigned his commission to a younger brother, and received from the crown, for his past services, 100*l.* a-year. He travelled to different countries in company with his pupil, and resided with him some time at the Hague. By the death of king William he was deprived of his pension, and his engagement as private tutor being over, he retired, in 1707, to Wesel, in the duchy of

of Cleves, where he devoted himself to the composition of the history of England. Here he died in 1725. He had, previously to his decease, published in the year 1717, "Dissertation sur les Whigs et Torys," which was translated into English. His great work, "L'Histoire de Angleterre," was printed at the Hague in 9 vols. 4to. in the years 1725-6. It commences with the remotest periods, and is brought down to the proclamation of William and Mary. It has been twice translated into our own language, and was, till the appearance of Hume, the most popular history of England, and Tindal's, or rather Birch's, and other continuations, have been adapted to it. It is written in a prolix and unanimated style, but deserves the praise of much solid information. "His work," says an excellent writer, "is of great authority, on account of his perpetual references to original documents, and the ample quotations which he frequently makes from important state papers, confer upon it additional value. He has so copiously detailed the matters which were agitated in the turbulent, but prudent parliament of Charles I., as to give a clear view of the rise of those parties which to this day divide the people of England. On the dark and horrible transactions of the reign of Charles II. he perhaps throws as much light as it is now possible to obtain. In reference to that important period, he has stated historical difficulties with candour, and in discussing the merits and demerits of parties, he has weighed evidence with laudable scrupulosity." (See Shepherd's Systematic Education.) Rapin, during the collection of his materials, undertook the useful labour of making an "Abridgment of Rymer's Foedera," which was published in Le Clerc's "Bibliothèque Choisie;" and translated into the English by Mr. Stephen Whatley, and published in 1733, under the title of "Acta Regia," and in folio.

RAPINE, *RAPINA*, in *Law*. To take a thing in private; against the owner's will, is properly *theft*; but to take it openly or by violence, is *rapine*, or *robbery*.

RAPINIA, in *Botany*, was so called by Loureiro, Fl. Cochinch. 127, after father René Rapin, a French Jesuit, author of an elegant Latin poem on gardens, who died in 1687, aged 66. If this writer contributed nothing to improve the science of botany, he has, doubtless, helped to promote a love of plants, and may therefore claim a botanic wreath. A Jesuit of his day is doubly entitled to respect, for having, like the good Loureiro, turned his mind to an elegant and improving pursuit, from those two corruptors of the human heart and understanding, political intrigue, and scholastic divinity; in which most of his brethren fought their temporal, and ostensibly their eternal, good. The *Rapinia* of Loureiro however, proved, on the examination of his specimens by the late Mr. Dryander, to be the *SPHENOCLEA* of other authors; and this last-mentioned name is now generally adopted. See that article.

RAPINO, in *Geography*, a town of Naples, in Abruzzo Citra; nine miles S. of Civita di Chieti.

RAPISTRUM, in *Botany*, originally the wild turnip, so called from its affinity to *Rapa*, the cultivated one. Tournefort, however, uses the word generically, for some species referred by other botanists to *Myagrum*. In this he is followed, as far as concerns *M. paniculatum*, by Gærtner, and by the writer of the present article, in the Prodr. Fl. Græc.—Tourn. t. 99. Gærtner. v. 1. 285. t. 141. Sm. Prodr. Fl. Græc. Sibth. v. 2. 1. Brown in Ait. Hort. Kew. v. 4. 74.—Class and order, *Tetradynamia Siliculosa*. Nat. Ord. *Silquosæ*, Linn. *Crucifera*, Juss.

Gen. Ch. *Cal.* Perianth inferior, of four oblong, spreading, deciduous leaves, gibbous at the base. *Cor.* cruciform, of four obovate, entire, spreading petals, whose claws are shorter

than the calyx. *Stam.* Filaments six, about the length of the calyx, the four opposite ones rather the longest; anthers simple. *Pist.* Germen oblong; style awl-shaped, the length of the calyx; stigma obtuse. *Peric.* Pouch lenticular, pointed, corrugated, of two cells, and two cohering, not spontaneously separating, coriaceous valves; partition membranous. *Seeds* roundish, solitary in each cell; cotyledons flat.

Eff. Ch. Calyx spreading. Pouch of two cells, and two convex valves, not bursting.

1. *R. paniculatum*. Panicle Rapistrum. Ait. n. 2. (*R. arvense*, folio auriculato acuto; Tourn. Inst. 211. *Myagrum paniculatum*; Linn. Sp. Pl. 894. Willd. Sp. Pl. v. 3. 409. Fl. Dan. t. 204. *Myagrum similis*, filiquâ rotundâ; Bauh. Prodr. 52.)—Native of cultivated fields in various parts of Europe, from Sweden to Greece, but not, as yet, observed in Britain. *Root* annual, tapering. *Stem* about two feet high, erect, round, roughish, leafy, branched. *Leaves* oblong, acute, undivided, rough, somewhat toothed, clasping the stem with their arrow-shaped base. *Flowers* small, yellow, in numerous clusters, which become greatly elongated when in fruit. *Pouch* scarcely bigger than mustard-seed, a little abrupt, finely reticulated. One of the *seeds* is often, but not always, abortive. Mr. Brown refers to this genus the *Bunias ægyptiaca* of Linnæus, which agrees with our *R. paniculatum* in having flat, not spiral, cotyledons, but has otherwise the characters of *Bunias*.

RAPISTRUM is also a species of the *sea-cabbage*, or *crambe*.

RAPOLLA, in *Geography*, a town of Naples, in Basilicata, the see of a bishop, united to Melfi; six miles W. of Venosa. N. lat. 40° 58'. E. long. 15° 44'.

RAPORE, a town of Naples, in Principato Ultra; 9 miles E. of Conza.

RAPOSO, a town of South America, in the country of Popayan.—Also, a river of Popayan, which runs into the Pacific ocean, N. lat. 3° 48'.—Also, a small island in the Pacific ocean, near the coast of Popayan. N. lat. 4°.

RAPPAHANOCK, a large navigable river of Virginia, which rises in the Blue Ridge, and runs about 130 miles from N.W. to S.E., and enters Chesapeake bay, between Windmill and Stingray points. Its waters, in its course, the towns of Falmouth, Fredericksburg, Port-Royal, Leeds, Tappahannock, and Urbane.

RAPPE, in *Commerce*, a money of account in Switzerland, 10 of which are equal to a good batze; and 6 are equal to a plappert, shilling, or escalin. This is the case at Basle, but at Lucern the plappert is only 3 rappen, and the Zurich escalin = 3 $\frac{3}{4}$ rappen.

RAPPE, in *Ichthyology*, a name given by some to the *capito fluvialis rapax* of Gelfner, more frequently known by the name of the *corvus piscis*.

RAPPERSCHWÊIT, in *Geography*, a town of Switzerland, and capital of a district to which it gives name; situated on the N. side of the lake of Zurich, over which there is a bridge, 1852 paces in length, built in 1358 by the counts of Habsburg. The town was founded in 1091, and formerly had its own counts. In 1358 it was sold to the sons of Albert, archduke of Austria. In 1464 it put itself under the cantons of Uri, Schwitz, Unterwalden, and Glarus, with a reserve of its liberties; but the cantons gradually made themselves masters of it. At the peace of Arau in 1712, its liberties were restored, though the country remains subject to the sovereignty of Zurich and Berne; 15 miles S.E. of Zurich.

RAPPIN, a town of Anterior Pomerania; 7 miles N. of Bergen.

RAPPO RAPPO, a bay on the coast of Mowee, one of the Sandwich islands.

RAPPOLTSKIRCHEN, a town of Austria; five miles S. of Tulln.

RAPPORT, Fr. in *Musée*, is sometimes used for proportion, and sometimes for relation, words which will be explained in their places.

RAPPS, in *Geography*, a town of Austria, on the river Taya; four miles S.W. of Drosendorf.

RAPSO, a town of Istria; 52 miles S.E. of Capo d'Istria.

RAPTEC, a river of Hindoostan, which runs into the Dewah, five miles S.W. of Silempour.

RAPTU HÆREDIS, in *Law*, an ancient writ which lies for taking away an heir, holding in socage; of which there are two sorts; one when the heir is married, the other when not. See RAVISHMENT.

RAPTURE, RAPTURA, an extasy, or transport of mind. See EXTASY, ENTHUSIASM, RHAPSODY, &c.

RAPUNCULUS, in *Botany*, the Rampion, owes its name to a resemblance in the root to a Rape, or oblong Turnip. This root, *Campanula Rapunculus* of Linnæus, is biennial, scarcely larger than a radish, which it resembles also in shape, but the colour is white. Its flavour is sweet and mild, notwithstanding some degree of milkiness in the juices, in which it accords with other, usually bitter and acrid, species of its genus. The Rampion is now much less cultivated than formerly, and almost a stranger at our tables.

RAPUNTUM, a name used by Tournefort and Morison for some plants referred to *Lobelia* by Linnæus. See LOBELIA.) Gærtner, having adopted Plumier's *Lobelia*, the Linnæan *Scaevola*, restores *Rapuntium*; but such a measure could now lead to inconvenience only.

RAPUTIA, so called by Aublet, because the plant grows in the forests of *Orapu* in Guiana. Jussieu and Lamarck have retained this curious name. Schreber has changed it for *SCIURIS*; see that article hereafter.

RARAKIT, in *Geography*, a town of the island of Ceram, at the foot of a mountain covered with trees, which serves as a harbour for pirates.

RARE, in *Physics*, denotes a body that is very porous, whose parts are at a great distance from one another, and which contains but little matter under a great deal of bulk.

In this sense *rare* stands opposed to *dense*.

The corpuscular philosophers, viz. the Epicureans, Gassendists, Newtonians, &c. assert that bodies are rarer some than others, in virtue of a greater quantity of vacuity included between their pores. The Cartesians hold, that a greater rarity only consists in a greater quantity of *materia subtilis* included in the pores. Lastly, the Peripatetics contend, that rarity is a new quality superinduced upon a body without any dependence, either on vacuity, or subtle matter.

RARECOURT, in *Geography*, a town of France, in the department of the Meuse; 10 miles S.W. of Verdun.

RAREE, a town of Hindoostan, in Concan; 20 miles N.N.W. of Goa.—Also, a town of Hindoostan, in Bahar; 11 miles N.N.W. of Durbungah.

RAREFACTION, RAREFACTIO, in *Physics*, the act by which a body is rendered *rare*; that is, is brought to possess more room, or appear under a larger bulk, without accession of any new matter.

Rarefaction is opposed to *condensation*.

Our more accurate writers restrain rarefaction to that expansion of a mass into a larger bulk, which is effected by

means of heat. All expansion from other causes they call *dilatation*.

The Cartesians deny any such thing as absolute rarefaction: extension, with them, constituting the essence of matter, they are obliged to hold all extension equally full.

Hence, they make rarefaction to be no other than an accession of fresh, subtle, and insensible matter, which, entering the parts of the body, sensibly distends them. See this disproved under VACUUM.

It is by rarefaction that gunpowder has its effect; and to the same principle also we owe our æolipiles, thermometers, &c.

The degree to which the air is rarefiable exceeds all imagination: Merfennus, long ago, by means of an intense heat, found that air might be rarefied so as to possess more than seventy times its former space.

Mr. Boyle afterwards found, that air, by its own elasticity, and without the help of any heat, would dilate itself so as to take up nine times its former space; then 31 times; then 60; then 150: at length, by many degrees, he found it would reach to 8000 times, then 10,000, and finally to 13,679.

Such is the rarefaction of common air, from its own principle of elasticity, and without any previous condensation; but if it be compressed, the same author found its greatest space when most rarefied, is to its least when most condensed, as 55,000 to 1.

Such an immense rarefaction, sir Isaac Newton shews, is inconceivable on any other principle than that of a repelling force inherent in the air, by which its particles mutually fly from one another.

This repelling force, he observes, is much more considerable in air than in other bodies, as being generated from the most fixt bodies, and that with much difficulty, and scarcely without fermentation; those particles being always found to fly from each other with the most force, which, when in contact, cohere the most firmly. See AIR.

The members of the French Royal Academy have bestowed much attention on the different rarefactions, or rather the different rarities of the air at different heights. M. Mariotte established this as a principle, from experiments, that the different rarefactions, or condensations, of the air, follow the proportion of the weights with which it is pressed.

Hence, supposing the mercury in the level of the sea suspended to twenty-eight inches, which is the weight of the whole atmosphere; and that sixty feet height of air are equivalent to a line, or one-twelfth of an inch of mercury; so that the barometer, at the height of sixty feet from the sea, would fall a line; it is easy finding what height of air would be equal to a second, or any other line of mercury: for as twenty-eight inches of mercury one-twelfth are to twenty-eight inches, so is the height of sixty feet of air to a fourth term, which is the height of air corresponding to a second line of mercury.

And after the same manner may the height of air corresponding to each line be found; which will make a geometrical progression, the sum of which will be the whole height of the ATMOSPHERE (which fee); and, of consequence, a certain part of that sum will be the height of a mountain, at whose top the barometer shall have sunk a certain quantity.

Messrs. Cassini and Maraldi, upon measuring the heights of several mountains, found, that this progression of M. Mariotte was defective; that it always gave the height of the mountains, and consequently the rarefactions, less than they really were; and from some farther experiments,

M. Amon-

M. Amontons found, that the principle will only hold in the mean rarefactions, not in the extremes. See **BAROMETER**.

RAREN, or **RARON**, in *Geography*, a town of the Valais, and capital of a tithing; 21 miles E. of Sion.

RARGIARA, a town of Hindoostan, in Bahar; 32 miles S.W. of Bahar.

RARITON, a river of America, in New Jersey, formed by two considerable streams, called the north and south branches; the one rises in Morris county and the other in the county of Hunterdon. This river passes by Brunswick and Amboy, and, uniting with the waters of the Arthur Kull found, helps to form the fine harbour of Amboy. At Rariton hills, through which this river passes, is a small cascade, with a fall of water from fifteen to twenty feet, romantically situated between two rocks. Copper ore has been found upon the upper part of this river.

RARITON, a town of New Jersey, situated between the mouth of the N. branch of the above river and Boundbrook; 12 miles N.W. of Brunswick.

RARO, a town of Hungary; 8 miles E.S.E. of Altenburg.

RARONGHAKON, a large lake of Thibet. N. lat. $31^{\circ} 4'$. E. long. $85^{\circ} 52'$.

RARUM, *Non-Spissum*, in the *Ancient Music*. See **APYCNON**.

RAS, in *Geography*, a town of Syria, anciently called "Conna," situated near the source of the Orontes; 24 miles N. of Balbec.

RAS Abad, or **Baba**, a cape on the coast of Arabia, in the Red sea; 10 miles S.S.W. of Jiddah.

RAS-Acon-natter. See **CAXINES**.

RAS Adder. See **CAPE BON**.

RAS Ababaz, a cape on the coast of Arabia, in the Red sea. N. lat. $18^{\circ} 19'$. E. long. $37^{\circ} 48'$.

RAS Ain, or **Ain Verdeb**, a town of Asiatic Turkey, in the province of Diarbekir; 80 miles S. of Diarbekir. N. lat. $36^{\circ} 34'$. E. long. $39^{\circ} 48'$.

RAS el Amoufse, a cape of Africa, on the coast of Algiers; 42 miles E. of cape Tennes. N. lat. $36^{\circ} 41'$. E. long. $2^{\circ} 48'$.

RAS Affab, a cape on the coast of Abyssinia, in the Red sea. N. lat. $13^{\circ} 8'$. E. long. $43^{\circ} 10'$.

RAS el Camir or **Kansir**, or cape of the wild boar, a town of Syria, in the pachalic of Aleppo, near a cape on the sea-coast; 16 miles W. of Alexandretta.

RAS el Doar, a cape on the coast of Nubia, in the Red sea. N. lat. $21^{\circ} 21'$. E. long. $36^{\circ} 9'$.

RAS el Anf or **Enf**, i. e. cape of the Rose, a cape on the coast of Egypt, in the Red sea; without tree or herb; in the front of the point are the remains of a large temple. N. lat. $23^{\circ} 57'$.

RAS Fartach. See **FARTACH**.

RAS Fillam, a cape on the E. coast of Arabia; 18 miles S.E. of cape Mozendum. N. lat. $29^{\circ} 59'$.

RAS Ibrahim, a cape of Arabia, in the Red sea; 6 miles S. Ghunfude.

RAS Iggidid, or **Ras el Jidid**, a cape of Nubia, in the Red sea; near which is a harbour, resembling a cauldron, and round as the arch of a circle; the entrance is formed by two points, N. and S. of each other, with 18 fathoms of water, and in the harbour 13. This port is subject to no inconvenience, except from the east. N. lat. $22^{\circ} 15'$. E. long. 36° .

RAS al Mabbes, a cape of Africa, on the coast of Tripoli. N. lat. $32^{\circ} 18'$. E. long. $11^{\circ} 49'$.

RAS Mohammed, a cape on the coast of Arabia, in the Red sea. N. lat. $27^{\circ} 54'$.

RAS al Mar, a town of Persia, in the province of Segestan; 200 miles S.W. of Zareng.

RAS al Nafhes, a cape of Egypt, in the Red sea. N. lat. $23^{\circ} 16'$.

RAS Rouzé, a cape on the E. coast of Arabia. N. lat. $21^{\circ} 55'$.

RAS Viré, a cape on the coast of Arabia, forming the S. point of the gulf of Curia Muria. N. lat. $17^{\circ} 25'$.

RAS Zafrane, a cape on the coast of Egypt, in the Red sea; 32 miles S.S.E. of Suez. N. lat. $29^{\circ} 14'$.

RASA, a small island in the Indian sea, near the coast of Africa. S. lat. $17^{\circ} 8'$.

RASAIN, a town of Persia, in the province of Fars or Faristan; 110 miles N.W. of Schiras or Shiraz.

RASAI, or **RASAL-SEM**, *Cape*, a cape of Africa, on the coast of Tripoli. N. lat. $32^{\circ} 36'$. E. long. $21^{\circ} 10'$.

RASALEMA, a river of Africa, which waters the city of Fez.

RASALGATA, **CAPE**, or **Ras Roufe**, a cape on the E. coast of Arabia. N. lat. $22^{\circ} 25'$. E. long. $58^{\circ} 15'$.

RASANT, or **RAZANT flank**, in *Fortification*. See **FLANK**.

The defence of the bastion is rasant.

RASANT Fire. See **FIRE**.

RASCA, in *Geography*, a river of Servia, which joins the Ibar; 16 miles N.E. of Jenibasar.

RASCETA, a word used by the Arabian physicians to express the wrist or ankle.

RASCH, in *Geography*, a town of Bavaria, in the territory of Nuremberg; two miles S.S.E. of Altorf.

RASCHNA, or **RIZANA**, a town of Servia; eight miles S. of Parakin.

RASCHOWITZ, a town of Bohemia, in the circle of Leitmeritz; four miles E. of Aufsee.

RASCIA, a port of Servia, watered by the Rasca.

RASCINES, a town of Spain, in the province of Biscay; 21 miles S.E. of Santander.

RASE, **RASARIUM**, in our *Old Writers*, seems to have been a measure of corn now difused; toll shall be taken by the rase, and not by the heap or cantel.

RASE, in the *Manege*. *To rase*, or glance upon the ground, called in French *razer le tapis*, is to gallop near the ground, as our English horses do.

RASEB, **AL**, in *Geography*, a fortified pass in the mountains of Grand Bucharia; 60 miles N. of Vashgherd.

RASEBORG, a sea-port town of Sweden, in the gulf of Finland; 30 miles S.E. of Abo.

RASEC, a town of Persia, in the province of Segestan; 60 miles S.W. of Zareng.

RASGRAD, or **RASGRAT**. See **HRASGRAD**.

RASH, in *Clock-Work*. See **RATCH**.

RASH, in *Medicine*, an eruption or efflorescence upon the skin, thrown out in fevers, or surfeits.

RASHAUA, in *Geography*. See **RASSAGU**.

RASHED, a town of Nubia, in Sennaar; 15 miles N. of Gieslim.

RASICULMO, **CAPE**, a cape on the N. coast of Sicily. N. lat. $38^{\circ} 18'$. E. long. $12^{\circ} 49'$.

RASIERE, or **RAZIERE**, in *Commerce*, a measure of corn in Dunkirk and Flanders. At Dunkirk, they have the sea rasiere, and the land rasiere; 8 of the former being = 9 of the latter; 54 sea rasiere or $60\frac{3}{4}$ land rasiere answer to 31 English quarters. Each sea rasiere contains 9884 inches, and each land rasiere contains 8786 inches; 17.40 of the former, and 19.57 of the latter, are equal (each) to 10 English

English quarters. At Dixmude 29.51 rasiere are equal to 10 English quarters, and each rasiere contains 5821 inches. At Gravelines 21.29 rasiere are equal to 10 English quarters, and each contains 8080 inches. At Nieuport 16.93 rasiere are equal to 10 English quarters, and each rasiere contains 10157 cubic inches. At Ostend 16.02 rasiere are equal to 10 English quarters, and each of them contains 10733 inches. At St. Omer 21.77 rasiere = 10 English quarters, and each contains 7900 cubic inches. At Lille or Lille, the rasiere is divided into 8 parts; of these there are two sorts, one, used for wheat or rye, the other, called rasiere de Mars, for oats or beans; 38 of the former, and 40 of the latter, are reckoned for one last. The rasiere of wheat weighs about 128lbs., and 41 of these are equal to 19 setiers, Paris measure, or about 10½ English quarters; 39.64 rasiere of Lille are equal to 10 English quarters, and each contains 4339 cubic inches.

RASILIS ERUGO, in the *Materia Medica of the Ancients*, one of their kinds of verdigris. It was prepared in the following manner; they set some sharp vinegar over the fire in a strong earthen vessel, and covered it with a brass pot inverted, well cleaned, and without any vent-hole. And after some time the vessels were to be separated; and the verdigris, which was found concreted on the inside of the brass pot, was scraped off, and put up for use.

RASILITA, in *Geography*, a town of Italy, in Friuli; 26 miles S.S.E. of Friuli.

RASIN, a town of Hindoostan, in Dowlatabad; 18 miles W.S.W. of Carmullah.

RASINTA, a town of Italy, in Friuli; 14 miles N. of Udina.

RASKOW, a town of Poland, in the palatinate of Braclaw; 54 miles S. of Braclaw.

RASMAN, an island in the Red sea. N. lat. 13° 58'.

RASMEND, a mountain of Persia, in the province of Irak; 60 miles N.E. of Nehavend.

RASNO, an island in the Adriatic. N. lat. 44° 6'. E. long. 15° 25'.

RASO, or Ell of Turin, in *Commerce*, is equal to 2½ Genoese palmi, or 23½ English inches; the foot 143.2 French lines, or 3¼ English inches; hence 180 Piedmontese rasi are equal to 119 English yards, and 33 Piedmontese feet = 35 English feet. At Cagliari, 166.7 rasi = 100 English yards, and each of them equal to 21.6 English inches. At Chamberry 158.5 rasi = 100 English yards, and each = 22.7 English inches. At Nice, 166.7 rasi = 100 English yards, and each = 21.6 English inches; 154.5 rasi of Turin = 100 English yards, and each = 23.3 English inches.

RASP, a coarse sort of file.

RASPACH, in *Geography*, a town of Austria; eight miles E. of Zwettl.

RASPATORIUM, (from *rado*, to scrape,) a surgical instrument with which the periosteum was, by the old practitioners, scraped from the bones, and the bones themselves sometimes rasped.

RASPBERRY BUSH, in *Botany*. See RUBUS.

For the dietetic and medicinal use of raspberries, see SUMMER FRUITS.

RASPECON, in *Ichthyology*, a name given by some to the uranoscope, or star-gazer.

RASPENBURG, in *Geography*, a town of Germany, in the principality of Weimar, near which are some medicinal springs; 12 miles N. of Weimar. N. lat. 51° 13'. E. long. 11° 35'.

RASPHUYS, or *Rasp-houfe*, a celebrated work-house, or house of correction, at Amsterdam. See WORK-HOUSE.

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RASPUGLY, in *Geography*, a town of Bengal; four miles S. of Calcutta.

RASSADES, a cluster of small islands, in the river St. Lawrence. N. lat. 48° 15'. W. long. 68° 48'.

RASSAGU, one of the Kurile or Kurilskoy islands, lying 40 versts from Mutova, and in extent about 30 versts measured either way. It has lofty mountains and steep rocky shores, with very few sandy bogs. On the mountains, here and there, is a good forest of birch, alders, and the nut-bearing pine; the vales and flats abound in herbs. On the land is no other animal besides the fox, but the cliffs of the rock afford nesting-places for all kinds of sea-birds; and the beavers and seals lie scattered on several parts of the strand. Here are no streams that yield fish. The Kurils on this island are not numerous, and some of them are baptized. N. lat. 48° 20'. E. long. 154° 14'.

RASSE CORONDE, in *Natural History*, a name given by the Ceylonese to a peculiarly fine kind of cinnamon, which is the bark of a tree, growing no where but in that island. The name they give it signifies *sharp* or *biting cinnamon*. This choice kind was formerly exported annually, in considerable quantity, by the Dutch East India company, who prohibited the mixing any other kind of cinnamon with it, under a very severe penalty. Phil. Transf. N° 409.

RASSOOLPOUR, in *Geography*, a town of Hindoostan, in the circar of Nagore; 22 miles N.W. of Didwana.—Also, a town of Hindoostan, in the circar of Gohud, on the Jumnah; 40 miles E. of Gohud.

RASSOVAT, or AXIOPOLI, a town of European Turkey, in Bulgaria; 24 miles N. of Dristra. N. lat. 44° 25'. E. long. 27° 37'.

RASTADT, a town of the duchy of Baden, situated on a large plain on the river Merg; the town is new, and regularly built, and the principal street is broad and handsome; 16 miles S.W. of Durlach. N. lat. 48° 52'. E. long. 8° 15'.—Also, a town of Bavaria, in the bishopric of Bamberg; five miles N.W. of Bamberg.—Also, a town of the duchy of Wurzburg; three miles S. of Melrichstadt.

RASTAGARA, a town of Egypt; 90 miles E. of Cairo.

RASTEDE, a town of Germany, in the country of Oldenburg; 11 miles N. of Oldenburg.

RASTENBURG, a town of Prussia, in the province of Natangen, founded in 1329, and after having been destroyed by the Lithuanians in 1348, was rebuilt, together with its castle, and put into a better state of defence; it is enclosed by a wall, and, in 1669, surrounded by a rampart. The burghers, most of whom are Lutherans, are about 200. The inhabitants derive their subsistence from a little commerce, brewing, agriculture, and mechanic trades; 46 miles S.E. of Königsberg. N. lat. 53° 58'. E. long. 21° 27'.

RASTICO HARBOUR, *Grand*, a bay in the gulf of St. Lawrence, on the N. coast of the island of St. John. N. lat. 46° 25'. W. long. 62° 50'.

RASTORFF, a town of Austria; seven miles E. of Ehrnsprunn.

RASTOWICA, a river of Poland, which runs into the Dnieper, on the borders of Russia.

RASURA, a word used by the pharmaceutic writers to express the shavings of woods, or other hard substances, to make them readily yield their virtues by decoction. Physicians also use it to express the corrosion of acrid humours.

RASURE in a *Deed*, in *Law*. See DEED.

RASZNA, in *Geography*, a town of Servia; 24 miles N. of Nissa.

RAT, in *Zoology*. See MUS.

It has been observed that this country was formerly infested with two kinds of rats, the *house-rat* and the *water-rat*; but that it is believed that the latter, within this last half century, has destroyed the former. This is probably, however, only imaginary, since it is well known that the house-rats are frequently brought, in great abundance, into the different sea-ports of the kingdom, in corn, and other vessels. It seems not improbable, but that these different varieties of rats may intercopulate, and by that means the latter become house-rats, as there is considerable diversity in the colours of the house-rats, some approaching to nearly black, which is the natural colour of the water-rat, while the genuine house-rat is always of a darkish or dapple brown. In their habits they have some circumstances in which they agree, as in that of making burrows in the ground; but the water-rat is capable of living much in the water, and of feeding on fish and other aquatic animals, while the house-rat mostly lives upon grain, and other produce of that kind. The water-rats are also said, by Dr. Darwin, to eat the foliage as well as the seeds and fruits of vegetables, as he has seen a young rat of this kind devour a large leaf of the water-plantain (*Alisma plantago*). They likewise, as well as the house-rats, are destructive of young animals, such as ducklings, goslings, chickens, and rabbits. But the great mischief which the water-rats produce, is in feeding on, and destroying, the roots of a great variety of vegetables, in their innumerable burrows. The above writer remembers to have seen some new-planted apple-trees taken out of the ground with nearly the whole of their smaller roots eaten, and the larger ones peeled by them. With the house kind, they are, likewise, extremely destructive of the food of poultry, and swine, and of course are highly detrimental near waters. It is remarked by the above able writer, that as these animals, like the dog, are of a lascivious nature, and, as some materials have a strong scent, resembling, perhaps, that of their venereal orgasm, they are liable to be attracted by such smells, as dogs are, on the same account, he supposes, inclined to roll themselves in putrid carrion; and male cats to eat marum valerian, and cat-mint. It is of this principle that rat-catchers avail themselves, and by indulging the propensity, deceive them to their destruction, by blending with their favourite foods different strong-scented substances, such as the essential oil of rhodium, or musk, with the poisonous powders of *strychnos nux vomica*, or of *delphinium stivifragia*, or perhaps of arsenic.

The first step taken by rat-catchers, in order to clear a house, &c. of those vermin, is to allure them all together, to one proper place, before they attempt to destroy them; for there is such an instinctive caution in these animals, accompanied with a surprising sagacity in discovering any cause of danger, that if any of them be hurt, or pursued, in an unusual manner, the rest take the alarm, and become so shy and wary, that they elude all the devices and stratagems of their pursuers for some time after. The place where the rats are to be assembled, should be some closet, or small room, into which all the openings, but one or two, may be secured; and this place should be, as near as may be, in the middle of the house, or buildings. It is the practice, therefore, to attempt to bring them all together in some such place before any attempt be made to take them; and even then to avoid any violence, hurt, or fright to them, before the whole be in the power of the operator. In respect to the means used to allure them to one place, they are various; one of those most easily and efficaciously practised is the trailing some piece of their most favourite food, which should be of the kind that has the strongest scent, such as

toasted cheese, or broiled red-herring, from the holes or entrances to their access in every part of the house, or contiguous buildings, whence it is intended to allure them. At the extremities, and in different parts of the course of this trailed tract, small quantities of meal, or any other kind of their food, should be laid, to bring the greater number into the tracks, and to encourage them to pursue it to the centre place, where they are intended to be taken; at that place, where time admits of it, a more plentiful repast is laid for them, and the trailing repeated for two or three nights. But besides this trailing, and way-haiting, some of the most expert of the rat-catchers have a shorter, and, perhaps, more effectual method of bringing them together, which is, the calling them, by making such a kind of whistling noise as resembles their own call, and by this means, with the assistance of the way-baits, they call them out of their holes, and lead them to the repast prepared for them at the place designed for taking them. But this is much more difficult to be practised than the art of trailing; for the learning the exact notes, or cries, of any kind of beasts or birds, so as to deceive them, is a peculiar talent, not easily attained to in other cases.

And in practising either of these methods great caution must be used by the operator to suppress, and prevent, the scent of his feet and body from being perceived; which is done by overpowering that scent by others of a stronger nature. In order to this the feet are to be covered with cloths rubbed over with *assafœtida*, or other strong smelling substances; and even oil of rhodium is sometimes used for this purpose, but sparingly, on account of its dearness, though it has a very alluring, as well as disguising effect. If this caution of avoiding the scent of the operator's feet, near the track, and in the place where the rats are proposed to be collected, be not properly observed, it will very much obstruct the success of the attempt to take them; for they are very shy of coming where the scent of human feet lies very fresh, and intimates, to their sagacious instinct, the presence of human creatures, whom they naturally dread. To the above-mentioned means of alluring by trailing, way-baiting, and calling, is added another of very material efficacy, which is the use of oil of rhodium, which, like the *marum syriacum* in the case of cats, has a very extraordinary fascinating power on these animals. The oil is extremely dear, and therefore very sparingly used. It is exhaled in a small quantity in the place, and at the entrance of it, where the rats are intended to be taken, particularly at the time when they are to be last brought together in order to their destruction; and it is used also, by smearing it on the surface of some of the implements used in taking them, by the method before described, and the effect it has in taking off their caution and dread, by the delight they appear to have in it, is very extraordinary.

It is usual, likewise, for the operator to disguise his figure as well as scent, which is done by putting on a sort of gown or cloak, of one colour, that hides the natural form, and makes him appear like a post, or such inanimate thing; which habit must likewise be scented as above, to overpower the smell of his person; and besides this he is to avoid all motion, till he has secured his point of having all the rats in his power. When the rats are thus enticed and collected, where time is afforded, and the whole in any house or out-buildings are intended to be cleared away, they are suffered to regale on what they most like, which is ready prepared for them; and then to go away quietly for two or three nights; by which means those which are not allured the first night are brought afterwards, either by their fellows, or the

the effects of the trailing, &c. and will not fail to come duly again, if they are not disturbed or molested. But many of the rat-catchers make shorter work, and content themselves with what can be brought together in one night or two; but this is never effectual, unless where the building is small and entire, and the rats but few in number.

With respect to the means of taking them when they are brought together, they are various. Some entice them into a very large bag, the mouth of which is sufficiently capacious to cover nearly the whole floor of the place where they are collected; which is done by smearing some vessel, placed in the middle of the bag, with oil of rhodium, and laying in the bag baits of proper food. This bag, which before laid flat on the ground, with the mouth spread open, is to be suddenly closed when the rats are all in it. Others drive or frighten them, by slight noises or motions, into a bag of a long form, the mouth of which, after all the rats are come in, is drawn up to the opening of the place by which they entered, all other ways of retreat being secured. Others, again, intoxicate or poison them, by mixing with the repast prepared for them the cocculus indicus, or the nux vomica. A receipt for this purpose has appeared, which directs four ounces of cocculus indicus, with twelve ounces of oatmeal, and two ounces of treacle or honey, to be made up into a moist paste with strong beer; but if the nux vomica be used, a much less proportion will serve than is here given of the cocculus. Any similar composition of these drugs, with that kind of food the rats are most fond of, and which has a strong flavour, to hide that of the drugs, will equally well answer the end. If, indeed, the cocculus indicus be well powdered, and infused in strong beer for some time, at least, half the quantity here directed will serve as well as the quantity before mentioned. When the rats appear to be thoroughly intoxicated with the cocculus, or sick with the nux vomica, they may be taken with the hand, and put into a bag or cage, the door of the place being first drawn to, lest those which have strength and sense remaining should escape. By these methods, when well conducted, a very considerable part of the rats in a farm, or other house, and the contiguous buildings, may be taken and destroyed. But various other methods have been practised.

In the Transactions of the Bath Agricultural Society, the following compositions are advised for destroying these mischievous creatures, and which are stated to have been attended with great success. First, to a quart of oatmeal, add six drops of oil of rhodium, one grain of musk, and two or three of the nuts of nux vomica finely powdered; make them into pellets, and put them into the rat-holes. This, it is said, was at first greedily eaten, and did great execution; but the wise animals, after a time, ceased to eat it. Secondly; this consisted of three parts of oatmeal and one of slave's-acre, mixed well into a paste with honey. Pieces of this paste were laid in their holes, and again did great execution. Thirdly; this is a method of destroying them by laying a large box down on its front side, with the lid supported open by a string over a pulley; and by trailing toasted cheese and a red-herring from their holes to this box, and placing oatmeal and other food in it, which they are for a few nights to be permitted to eat unmolested; and finally to watch them by moon-light, the inside of the box being painted white; and, when many of them are seen, to let down the lid; by which contrivance sixty of them are stated to have been taken at one time.

But though the usual ways of destroying rats are by traps and poison, Mr. Forfyth advises never to use arsenic, or corrosive sublimate, for that purpose, except under parti-

cular circumstances, as they are deadly poisons: nux vomica will, he thinks, generally answer the end as well, without the danger. He suggests it as a very good plan, to prevent accidents, to enclose the traps in cases, having holes in the ends of them large enough to admit rats, but small enough to exclude dogs, cats, &c. And that, as a bait for rat-traps, the following composition may be made use of with advantage. Take a pound of good flour, three ounces of treacle, and six drops of the oil of carraways: put them all in a dish; and rub them well together till they are properly mixed: then add a pound of crumb of bread. The traps baited with this mixture should be set as near their haunts as possible; but, for two or three days, so as not to fall or strike on the rats going in, but letting them have free liberty to go in and out at pleasure, as this makes them fearless. Some of the bait should also, he thinks, be laid at the rat-holes, and a little of it scattered quite up to the traps, and so on to the bridge of each trap, where a handful may be placed. It may also, he thinks, be proper to scent the traps with the following mixture, for the purpose of enticing the rats into them. Take twenty drops of the oil of rhodium, six or seven grains of musk, and half an ounce of oil of aniseed; put them in a small phial, and shake it well before using; then dip a piece of twisted paper or rag in the mixture, and rub each end of the trap with it, if a box trap, and put two or three drops on the bridge, leaving the paper or rag in the trap. Of whatever kind the trap is, it should be scented; but once in a twelvemonth will be sufficient. Then throw some chaff mixed with a little wheat about the bottom of the trap, in order to deceive the rats; for they are very sagacious, and will not enter a suspicious place. This will be necessary to be done only at the first time of setting the traps; for, after some rats have been caught and have watered and dunged in them, rats will enter boldly when they find others have been there before them: do not, therefore, wash or clean out the trap, as some people do before they set it again, but let the dung and urine remain in it. Keep the places where the traps are set as private as possible; and when they are set for catching, mix no bread with the bait, as the rats will, in that case be apt, to carry it away.

And it is useful, this writer remarks, when the holes are found quiet, and that no rats use them, to stop them up with the following composition. Take a pint of common tar, half an ounce of pearl-ashes, an ounce of oil of vitriol, and a good handful of common salt, mix them all well together in an old pan or pot. Take some pieces of paper, and lay some of the above mixture very thick on them; then stop the holes well up with them, and build up the mouth of the holes with brick or stone, and mortar; if this be properly done, rats will, he asserts, no more approach these while either smell or taste remains in the composition.

But with a view to destroy rats in places where traps cannot be set, it is recommended to take a quart of the above bait, then to rasp into it three nuts of nux vomica, and add a quarter of a pound of crumb of bread, if there was none before; mix them all well together, and lay it into the mouth of their holes, and in different places where they frequent; but first give them of the bait without nux vomica, for three or four succeeding nights; and when they find it agrees with them, they will eat that mixed with the nut with greediness.

However, as it is frequently found that rats are very troublesome in sewers and drains, in such cases arsenic may be used with success in the following manner. Take some dead rats, and having put some white arsenic, finely powdered, into an old pepper-box, shake a quantity of it

on the fore-parts of the dead rats, and put them down the holes, or avenues, by the sides of the fewers at which they come in; this puts a stop to the live ones coming any further: for when they perceive the arsenic, they will retire immediately; whereas, if they were put down without the arsenic, the live ones would eat them.

It is by means of arsenic, notwithstanding the above observations, that the most certain method of destroying these troublesome vermin, (provided they can be made to eat it,) takes place; which we have found to answer best, when it is prepared by being finely levigated, and mixed up with very strong old cheese and oatmeal.

In a note in the Agricultural Survey of Lancashire, it is stated, that it is greatly to be lamented that Mr. Heathcote's method of destroying rats and mice is not generally known and practised; if it were, there would be a total extirpation of those obnoxious and destructive animals; for in one night he totally destroys them (where he is employed), be they ever so numerous, as can be well attested by hundreds in the neighbourhood of Ormskirk, who have employed him. And it is added, that the composition he makes use of he puts in their holes and burrows, and from the small quantity he uses, it is astonishing it should have such an effect: it will keep good two years. It is also stated, that a farmer recommends, for the destruction of rats, one ounce of pounded quick-lime to four ounces of tallow cake, to be beaten together and made into balls, and placed in their runs, which has cleared many buildings. But it has been proved by experience, it is said, that an ounce of aerated barytes finely powdered, mixed with the tallow, in place of lime, is more effectual. And it has been remarked by the author of Phytologia, with the view of destroying the water-rats, that they possess some kind of ingenuity similar to the beaver in the construction of their houses near the brinks of rivers and pools; which have two apertures, one above ground amongst the grafs, and the other beneath the surface of the water; and unless they can hide their upper opening amid weeds, or grafs, they forsake the situation. Thus, if a rim, three or four feet in breadth, round a fish-pond be kept so low as to rise only two, three, or four inches above the level of the water; and if this be kept clean from high grafs or weeds, the rats will desert the pond.

But after all, it is probable that this highly destructive animal, and great pest to the farmer, might be most readily exterminated by parishes uniting for the purpose, and raising certain sums of money to be applied in this way, under the direction of a proper person who is fully acquainted with the business.

In many grain and other districts in the kingdom these animals prevail very much, especially the grey kind, particularly in all those where there are no regular raised staddles or stands for the grain stacks to rest upon, which is the case in a great number. The mischief, injury, and destruction of grain which is produced in this way, is scarcely to be calculated; and they are besides very mischievous, troublesome, and inconvenient in several others; so that they should be every where extirpated as much as possible. And in corn tracts, stands or staddles should every where be provided in order to prevent mischief being done by them. See VERMIN, and STAND, Corn.

RAT, *Beaver*. See *Mus Cypus*.

RAT, *Black*. See *Mus Rattus*.

RAT, *Blind*. See *Mus Typhlus*.

RAT, *Field*. See *Mus Silvaticus*.

RAT *Mole*. See *Mus*.

RAT, *Mountain*. See *Marmot Talpinus*, &c.

RAT, *Musk*. See *Mus Zibethicus*.

RAT, *Norway or brown, mus Norwegicus*, (*Mus decumanus*) is a rat whose head, back, and sides are of a light brown colour, mixed with tawny and ash-colour; the breast and belly are of a dirty white; the feet naked, and of a dirty flesh-colour; the fore-feet are furnished with four toes, and a claw instead of the fifth: the length from the nose to the tail is nine inches, and the tail is of the same length. This animal is more strongly made than the common black rat, or *mus rattus*.

This species of rat, which is the same animal that is called in the East Indies a *bondicote*, now inhabits most parts of Europe; whither it is supposed to have been brought within the last century, in some of the India ships. It came into Great Britain about 70 or 80 years ago, but has not been known in the neighbourhood of Paris above half that time. They swarm in Petersburg, and are known in Prussia; but have not yet reached the opposite side of the Baltic, as Linnæus takes no notice of this species. These were probably the *mures Cassii* of Ælian, which made periodical visits in great multitudes to the countries bordering on the Caspian sea, swimming boldly over the rivers, holding by one another's tail. (Ælian. Hist. An. 17. cap. 17.) They burrow, like the water rat, on the sides of ponds and ditches; swim and dive well; live on grain and fruits, but will destroy poultry and game; increase fast, producing from fourteen to eighteen young at a time; are very bold and fierce; will turn, when closely pursued, and fasten on the stick or hand that offers to strike them: they have destroyed the common black rat in most places: they inhabit the fields part of the year, but migrate in great numbers into houses, and do much mischief. The bite of these rats is not only severe but dangerous; the wound being immediately attended with a great swelling, and healing very slowly. Pennant. See *Mus Decumanus*.

RAT, *Norway*, is also a name given by some writers to the lemming, or sable mouse. See *Mus Lemmus*, and *Sable Mouse*.

RAT, *Water*. See *Mus Amphibius*.

RAT, in the *Sea Language*, is used to express a part of the sea, where there are rapid and dangerous currents, or counter-currents.

RAT-Goose, in *Ornithology*, the name of a small species of wild goose, common in some of the northern counties of England.

RAT-Tails, in the *Manege*. See *ARRETS*.

RAT-Tailed. A horse is thus called that has no hair upon his tail.

RAT-Tailed Worms, in *Natural History*, a species of fly-worms with long tails, resembling those of rats, whence they have their name. They are of several sizes, and found also in different places, but all change into two-winged flies, having very much the resemblance of bees, and commonly called *bee-flies*. See *DRONE-Fly*.

RAT, *Cape*, in *Geography*, a cape of Africa, in the Red sea. N. lat. 14° 55'.

RAT *Island*, a small island in Milford Haven.—Also, an island in the Red sea. N. lat. 14° 55'.—Also, a small island in the East Indian sea, near the W. coast of Sumatra. S. lat. 3° 57'. E. long. 101° 55'.—Also, a small island in the Mergui Archipelago, S.W. of Olive island.

RATA *pro* RATA. See *PRO rata*.

Onerando pro Rata portionis. See *ONERANDO*.

RATAFIA, a fine spirituous liquor, prepared from the kernels, &c. of several kinds of fruits, particularly of cherries and apricots.

Ratafia of cherries is prepared by bruising the cherries, and putting them into a vessel in which brandy has been long kept;

kept; then adding to them the kernels of cherries, with strawberries, fugar, cinnamon, white pepper, nutmegs, cloves; and to twenty pounds of cherries, ten quarts of brandy. The vessel is left open ten or twelve days, and then stopp'd close for two months before it be tapped.

Ratafia of apricots is prepared two ways; *viz.* either by boiling the apricots in white wine, adding to the liquor an equal quantity of brandy, with fugar, cinnamon, mace, and the kernels of apricots; infusing the whole for eight or ten days; then straining the liquor, and putting it up for use: or else by infusing the apricots, cut in pieces, in brandy, for a day or two; passing it through a straining-bag, and then putting in the usual ingredients.

RATAN, in *Geography*, a small island on the W. side of the gulf of Bothnia. N. lat. $63^{\circ} 58'$. E. long $20^{\circ} 39'$.

RATCH, or RASH, in *Clock Work*, a sort of wheel having twelve fangs, which serve to lift up the detents every hour, to make the clock strike.

RATCHETS, in a *Watch*, are the small teeth at the bottom of the fusee, or barrel, which stop it in winding up.

RATCHIN LOP, in *Geography*, a large lake of Thibet. N. lat. $30^{\circ} 43'$. E. long. $82^{\circ} 27'$.

RATCLIFF, a town of America, in Maryland; 22 miles S. of Salisbury.

RATE, a standard or proportion, by which either the quantity or value of a thing is adjusted.

The rates of bread, &c. in London, are fixed by authority. See *Affix of BREAD*.

The rate of interest, as now established by law in England, is five *per cent.* The rate of interest in Italy, is three *per cent.*; in Sweden, six; in France, five; in Spain, ten; in Barbadoes, ten; in Ireland, twelve; in Turkey, twenty. Low rates of interest advance the prices of land.

The rates or fares of hackney-coachmen, chairmen, and watermen, are fixed by act of parliament. See *Hackney COACHES*, &c.

The rates of exchange, factorship, &c. are different. See *EXCHANGE*, *FACTORAGE*, &c.

RATE of a *Ship of War*, is its order, degree, or distinction, as to magnitude, burden, force, &c.

The British fleet is accordingly distributed into six rates, exclusive of the inferior vessels that usually attend on naval armaments; as sloops of war, armed ships, bomb-ketches, fire-ships, and cutters or schooners, commanded by lieutenants.

Ships of the *first* rate mount a hundred cannon, and some more, having forty-two-pounders on the lower deck, twenty-four-pounders on the middle deck, twelve-pounders on the upper deck, and six-pounders on the quarter-deck and fore-castle. They are manned with eight hundred and fifty men, including their officers, seamen, marines, and servants.

In general, the ships of every rate, besides the captain, have the master, the boatswain, the gunner, the chaplain, the purser, the surgeon, and the carpenter; all of whom, except the chaplain, have their mates or assistants, in which are comprehended the sail-maker, the master at arms, the armourer, the captain's clerk, the gunsmith, &c. The number of other officers is always in proportion to the rate of the ship. Thus, a first rate has six lieutenants, six master's mates, twenty-four midshipmen, and five surgeon's mates, who are considered as gentlemen; besides the following petty officers: quarter-masters, and their mates, fourteen; boatswain's mates, and yeomen, eight; gunner's mates and assistants, six; quarter-gunners, twenty-five; carpenter's mates, two, besides fourteen assistants; with one steward, and steward's mate to the purser.

Ships of the *second* rate carry ninety-eight and ninety

guns upon three decks; of which those on the lower battery are thirty-two-pounders; those on the middle, eighteen-pounders; on the upper deck, twelve-pounders; and those on the quarter-deck, six-pounders, which usually amount to four or six. Their complement of men is seven hundred and fifty, in which there are six lieutenants, four master's mates, twenty-four midshipmen, and four surgeon's mates, fourteen quarter-masters and their mates, eight boatswain's mates and yeomen, six gunner's mates and yeomen, with twenty-two quarter-gunners, two carpenter's mates, with ten assistants, and one steward and steward's mate.

Ships of the *third* rate carry from sixty-four to eighty cannon, which are thirty-two, eighteen, and nine-pounders. The eighty-gun ships, however, begin to lose their reputation, and give way to those of seventy-four, seventy, &c. which have only two whole batteries; whereas the former have three, with twenty-eight guns planted on each; the cannon of their upper deck being the same as those on the quarter-deck and fore-castle of the latter, which are nine-pounders. The complement in a seventy-four is six hundred and fifty; and in a sixty-four, five hundred men: having in peace, four lieutenants, but in war, five, and when an admiral is aboard, six. They have three master's mates, sixteen midshipmen, three surgeon's mates, ten quarter-masters and their mates, six boatswain's mates and yeomen, four gunner's mates and yeomen, with eighteen quarter-gunners, one carpenter's mate with eight assistants, and one steward and steward's mate under the purser.

Ships of the *fourth* rate mount from sixty to fifty guns, upon two decks and the quarter-deck. The lower tier is composed of twenty-four-pounders; the upper tier, of twelve-pounders; and the cannon on the quarter-deck and fore-castle are six-pounders. The complement of a fifty-gun ship is three hundred and fifty men, in which there are three lieutenants, two master's mates, ten midshipmen, two surgeon's mates, eight quarter-masters and their mates, four boatswain's mates and yeomen, one gunner's mate and one yeoman, with twelve quarter-gunners, one carpenter's mate and six assistants, and a steward and steward's mate.

All vessels of war under the fourth rate, are usually comprehended under the general name of frigates, and never appear in the line of battle. They are divided into the *fifth* and *sixth* rates, the former mounting from forty to thirty-two guns, and the latter from twenty-eight to twenty. The largest of the fifth rate have two decks of cannon, the lower battery being of eighteen-pounders, and that of the upper deck of nine-pounders; but those of thirty-six and thirty-two guns have only one complete deck of guns, mounting twelve-pounders, besides the quarter-deck and fore-castle, which carry six-pounders. The complement of a ship of forty-four guns is two hundred and eighty men; that of a frigate of thirty-six guns, two hundred and forty men. The first has three, and the second two lieutenants; and both have two master's mates, six midshipmen, two surgeon's mates, six quarter-masters and their mates, two boatswain's mates and one yeoman, one gunner's mate and one yeoman, with ten or eleven quarter-gunners, and one purser's steward.

Frigates of the sixth rate carry nine-pounders; those of twenty-eight guns having three-pounders on their quarter-deck, with two hundred men for their complement; and those of twenty-four, one hundred and sixty men: the former has two lieutenants; the latter, one; and both have two master's mates, four midshipmen, one surgeon's mate, four quarter-masters and their mates, one boatswain's mate and one yeoman, one gunner's mate and one yeoman, with six or seven quarter-gunners, and one purser's steward.

The

The sloops of war carry from eighteen to eight cannon : the largest of which have six-pounders ; and the smallest, viz. those of eight or ten guns, four-pounders. Their officers are generally the same as in the sixth rates, with little variation ; and their complements of men are from one hundred and twenty to sixty, in proportion to their force or magnitude.

Bomb-vessels are on the same establishment as sloops ; but fire-ships and hospital-ships are on that of fifth rates. If the dimensions of all ships of the same rate were equal, it would be easy to collect them into one point of view in a table ; but as there is no invariable rule for the general dimensions, we shall select those of some of a late construction in each rate.

Rates.	Guns.	Length of the keel.		Length of the lower deck.		Extreme breadth.		Depth in the hold.	Burthen in tons.
		Ft.	In.	Ft.	In.	Ft.	In.		
1st	Victory	100	151	3	186	0	51	10	2162
2d	Barfleur	90	144	0 $\frac{3}{4}$	177	6	50	0	1934
3d	Arrogant	74	138	0	168	3	47	4	1644
	Europa	64	139	0	159	0	44	4	1366
4th	Salisbury	50	120	8	146	0	40	4	1044
5th	Phoenix	44	116	11	140	9	37	1 $\frac{3}{4}$	856
	Venus	36	106	3	128	4 $\frac{1}{2}$	35	9	722
6th	Carysfort	28	97	3 $\frac{1}{2}$	118	4	33	8	586
	Dolphin	24	93	4	113	0	32	1	511
Sloop	Nautilus	16	80	7 $\frac{5}{8}$	98	0	27	2	316

Ships of one hundred guns, and above, and downwards to sixty-four, are termed ships of the line.

Ships of the line, fifties, frigates, and royal yachts, are commanded by post-captains ; sloops of war, bombs, fire-ships, armed ships, store-ships, and armed *en flûte*, under fifty guns, by commanders ; schooners, cutters, &c. by lieutenants ; sloop-ships occasionally by masters ; and small craft by midshipmen, who have passed for lieutenants.

Ships of the second rate, and those of the third, which have three decks, carry their sails remarkably well, and labour very little at sea. They are excellent in a general action, or in cannonading a fortress. Those of the third rate, which have two tiers, are fit for the line of battle, to lead the convoys and squadrons of ships of war in action ; and, in general, to suit the different exigencies of the naval service. The fourth rates may be employed on the same occasions as the third rates ; and may be also destined for service among the foreign colonies, or on expeditions of great distance ; since these vessels are usually excellent for keeping and sustaining the sea. Vessels of the fifth rate are too weak to suffer the shock of a line of battle ; but they may be destined to lead the convoys of merchant ships, to protect the commerce in the colonies, to cruise in different situations, to accompany squadrons, or be sent express with necessary intelligence and orders. The same may be observed of the sixth rates.

The frigates which mount from twenty-eight to thirty-eight guns upon one deck, with the quarter-deck, are extremely proper for cruising against privateers, or for short expeditions, being light, long, and usually excellent sailers. Falconer.

RATES, *Books of*. See BOOK and CUSTOMS.

RATE, *Poor*. See POOR.

RATE-Tithe. When sheep, or other cattle, are kept in a parish for less time than a year, the owner must pay

tithe for them *pro rata*, according to the custom of the place.

RATE, in *Geography*, a town of Hindoostan, in Mysore ; 25 miles E. of Rattighery.

RATEEN, or RATTEN, in *Commerce*, a thick woollen stuff, quilled, woven on a loom with four treddles, like ferges, and other stuffs that have the whale or quilling.

There are some rateens dressed and prepared like cloths ; others left simply in the hair ; and others where the hair, or knap, is frized.

Rateens are chiefly manufactured in France, Holland, and Italy ; and mostly used in linings.

The frize is a sort of coarse rateen ; and the drugget is a rateen half linen, half woollen.

RATEL, in *Zoology*, a name given by the Hottentots to an animal inhabiting the Cape of Good Hope, which lives on honey, and is a great enemy to bees : hence called the *VIVERRA Mellivora* : which see. It has a blunt black nose ; no external ears, but a small rim round the orifice ; a rough tongue, short legs, very long claws, which are straight like those of a badger, and guttered beneath : the colour of the forehead, crown, and whole upper part of the body, is a cinereous grey ; the cheeks, and space round the ears, throat, breast, belly, and limbs, black ; from each ear to the tail extends along the sides a dusky line, leaving beneath another of grey. Its length from the nose to the tail is forty inches, and the tail twelve.

This animal preys in the evening, and ascends to the highest parts of the desert to look about ; and will then put one foot before its eyes, to prevent the dazzling of the sun. The reason of its going to an eminence is for the sake of seeing or hearing the honey-guide cuckoo, or cuculus indicator, which lives on bees, and, as it were, conducts it to their haunts. Pennant.

RATENSTADT, in *Geography*, a town of Hungary ; 16 miles S.E. of Baes.

RATESPONTE *de Mulher*, a town of Portugal, in the province of Entre Duero e Minho ; 15 miles N.E. of Villa de Conde.

RATH, a word used in the composition of names of places in Ireland, as Rathdrum, &c. It signifies an intrenchment, or fort.

RATH, *ripe*, in *Agriculture*, a term applied to some early ripe corn crops, and which have a degree of redness in the straw ; such as some varieties of barley, &c.

RATHANGAN, in *Geography*, a post-town of the county of Kildare, Ireland, situated on the Athy branch of the Grand Canal ; 28 $\frac{1}{2}$ miles W. from Dublin, and 5 miles N.N.W. from Kildare.

RATHCONRATH, a small town of the county of Westmeath, Ireland, which gives name to a barony. It is 44 miles N. by W. from Dublin, on the road to Lanefborough, and 6 miles W. from Mullingar.

RATHCOOLE, a small post-town of the county of Dublin, Ireland, where fairs are holden for cattle and pedlars' wares. It is on the great southern road, 7 $\frac{1}{2}$ miles S.W. from Dublin.

RATHCORMUCK, a post-town of the county of Cork, Ireland, which returned two members to the Irish parliament, before the union. It has gone much to decay, in consequence of the prosperity of Fermoy, which is little more than three miles distant. It is near the river Bride, 111 miles S.W. from Dublin, and 13 $\frac{1}{2}$ N.E. from Cork.

RATHDOWNY, a post-town of the Queen's county, Ireland ; 59 miles S.W. from Dublin.

RATHDRUM, a post-town of the county of Wicklow, Ireland, situated on the river Ovoca. It has a monthly fair

fair for flannels, of which there is a considerable manufacture. The adjoining country is very interesting, and the Wicklow copper-mines are not far distant. Rathdrum is 29 miles S. from Dublin.

RATHENAU, or **RATEMAO**, a town of the middle mark of Brandenburg, on the Havel; 38 miles W. of Berlin. N. lat. $52^{\circ} 38'$. E. long. $12^{\circ} 30'$.

RATHER, or **NEITHIER**, a river of England, which runs into the Lune, four miles N. of Kirkby Lonsdale, in the county of Westmoreland.

RATHERIUS, in *Biography*, a very learned prelate in the tenth century, commenced his ecclesiastical career by embracing a monastic life at the abbey of Lobbes, or Laubes, in Flanders. Here he distinguished himself by his abilities and acquirements. In the year 928, after Hilduin had been driven out of the see of Liege, he accompanied him into Italy; and in 931 he was, by the express order of the pope, put in possession of the see of Verona. As, however, this was in direct hostility to the king of the country, he was exposed to much persecution, and at length banished from Italy. After spending five years in exile, he returned with the hope of regaining his bishopric: but he was unsuccessful, and was ordered to withdraw. He obeyed, and retired into Provence: from this place he went to the abbey of Lobbes, where the recollection of the honour, which he had formerly reflected on that establishment, secured him a welcome reception. Shortly after this, he was sent for by the emperor Otho, who placed him near the person of his brother Bruno. This prince, having been made archbishop of Cologne in the year 953, presented Ratherius to the bishopric of Liege; from which, however, he was driven in about two years. As the emperor Otho was at this time in Italy, our prelate made an effort to recover his former see of Verona. Accordingly he laid his case before a synod assembled at Pavia, which passed a decree that he should be re-established in that bishopric. His peace was soon interrupted by controversies with the clergy, who could not endure his reproofs of their irregularities and corruptions; till at length they became so irksome to him, that he determined to take his final leave of Italy. He accordingly went to France, where he purchased some estates, and obtained the abbies of St. Amand, Aumont, and of Aunay. He died at Namur, about the year 973. His works are numerous, some of which are inserted in father d'Achery's "Spicilegium." They are said to afford evident proofs of great sagacity and judgment, while they breathe throughout an ardent love of virtue. They also shew, that he was most zealous and intrepid in exposing the irregularities and vices of the times, and particularly the corrupt morals of ecclesiastics. Moreri. Mosheim.

RATHFRILAND, in *Geography*, a post-town of the county of Down, Ireland. It is situated on a rising ground, and has four great straight roads leading up to it, and centering in the town. It is on the road to Downpatrick, and much frequented. The neighbourhood abounds with granite of a close texture, and fit for building. On the summit of the hill are the ruins of a castle, formerly one of the residences of the Magennises, lords Iveach. Rathfriland is $57\frac{1}{2}$ miles N. from Dublin, and $7\frac{1}{2}$ miles N.E. from Newry.

RATHKEALE, a post-town of Ireland, in the county of Limerick. It is situated on the river Deel, and was formerly a corporation town, and of much more consequence than at present. It has several fairs, one of which for horses is much frequented, as are also its races. In the reign of queen Elizabeth, it sustained an attack of the English army. The ruins of a priory, founded by a person of

the name of Harvey, are still remaining. Rathkeale is 108 miles S.W. from Dublin, and 14 miles W.S.W. from Limerick.

RATHLACKEN, a post-town of the county of Mayo, Ireland, on the sea-coast, nor far from Rathlacken or Relakin head, and west of the entrance to Killala bay. It is 132 miles W.N.W. from Dublin, and 5 miles N. from Killala.

RATHLIN, **RAGHLIN**, or *Ragbery*, an island situated between the north coast of Antrim, in Ireland, and Scotland, and considered as belonging to the former. It is about five miles in length, and three quarters of a mile in breadth, being bent in an angle towards the middle. This angle lies opposite to Ballycattle, and forms a tolerable bay, called Church bay; but in a westerly wind, though the anchorage is good, few vessels can ride it out, from the swell along the coast. The number of plantation acres is about 2000, which support a population of about 130 or 140 families, amounting to about 1100 persons. The cultivated land is kindly enough, and produces excellent barley. But kelp is the great source of wealth to this island, 100 tons of which have been exported from it in one year. The horses, as well as the sheep, are small, but serviceable; and the black cattle are not large, though they do well when brought to the main land, and better soil. The inhabitants are a simple, laborious, and honest race of people, much attached to their own island, and regarding Ireland as a foreign country. The monuments of antiquity are small tumuli, in one of which, when opened, a stone coffin was found, beside which an earthen vessel stood. Within the tumuli lay a considerable number of human bones, which might have been the remains of more ignoble men than the person whose remains the coffin covered. Brazen swords and spear-heads have also been found. The remains of a fortress are visible, where Robert Bruce is said to have defended himself for some time, when obliged to fly from his country. N. lat. $55^{\circ} 20'$. W. long. $6^{\circ} 6'$.

RATHMANS DORF, a town of Silesia, in the principality of Neiss; 4 miles N.N.W. of Weidenau.

RATHOWEN, a post-town of the county of Westmeath, Ireland, near the borders of Longford; 48 miles W.N.W. from Dublin.

RATHSCHACH, or **RADESCHE**, a town of the duchy of Carniola, on the Save; 9 miles W.N.W. of Gurckfeld.

RATHSPRÆSENTGERS, in *Commerce*, silver coins of Aix-la-Chapelle, being double, single, or half pieces of 22, 16, and 8 marks. By the assay, the rathspræsentger is worse than the English standard of 11 oz. 2 dwts., by 4 oz. 2 dwts. Its weight is 4 dwts. $1\frac{1}{2}$ gr.; its content in pure silver 56.9 grs.; and its value in sterling 8d. The double of the same is worse by 2 oz. 15 dwts.; its weight 6 dwts. $23\frac{1}{4}$ grs.; its content in pure silver 116.3 grs.; and its value in sterling 1s. $4\frac{1}{4}$ d. This coin bears on one side an eagle within a circle, marked 16 on his breast, (32 on the double piece,) and within another circle the legend, REGUM CURIA PRINCIPALIS PRIMA; and next the edge, URBS AQUENSIS. URBS REGALIS. REGNI SEDES: on the other side, or reverse, an altar, with two swords and a crown over it, on the double piece; but on the single, a crown and the date within a circle: the legend on both is LOCUS CÆSARÆ CORONATIONIS; Cæsar being a general title for the emperor. Kelly's Un. Cambist.

RATI, in *Geography*, a small island in the Grecian Archipelago, near the S. coast of Nicaria.

RATIBOR, a town of Silesia, in a principality of its name, on the Oder, which here becomes navigable; 70 miles

miles S.E. of Breslau. N. lat. 50° . E. long. $18^{\circ} 5'$. The principality is bounded N. by the principality of Oppeln, on the E. by Poland, on the S. by Teschen, and on the W. by the principality of Jagendorf. Its soil is better than that of Oppeln, as it produces a sufficient supply of wheat, rye, and barley, with fruits; and besides, it has also good pasture grounds. Its only river is the Oder, which passes through its western part; but it is abundantly watered in all its parts with streams, ponds, and lakes. It contains only three cities, and the inhabitants are universally Polish. It became a principality in 1288, and about 200 years afterward it was united to Oppeln, from which it has never been separated.

RATIFICATION, *RATIFICATIO*, an act, approving of, and confirming, something done by another, in our name.

A treaty of peace is never secure till the princes have ratified it.

All procuration imports a promise of ratifying and approving what is done by the proxy, or procurator: after treating with a procurator, agent, factor, &c. a ratification is frequently necessary on the part of his principal.

RATIFICATION is particularly used, in our *Laws*, for the confirmation of a clerk in a benefice, prebend, &c. formerly given him by the bishop, &c. where the right of patronage is doubted to be in the king.

RATIFICATION is also used for an act confirming something we ourselves have done in our own name.

An execution, by a major, of an act passed in his minority, is equivalent to a ratification.

RATING. See **RAITING**.

RATINGEN, or **RATTINGEN**, in *Geography*, a town of the duchy of Berg; $\frac{1}{4}$ miles N.E. of Dusseldorp. N. lat. $51^{\circ} 15'$. E. long. $6^{\circ} 47'$.

RATINO, a town of Naples, in the county of Molise; 6 miles S.E. of Molise.

RATIO, in *Arithmetic* and *Geometry*, that relation of homogeneous things, which determines the quantity of one from the quantity of another, without the intervention of any third.

The homogeneous things, thus compared, we call the *terms of the ratio*; particularly that referred to the other, we call the *antecedent*; and that to which the other is referred, the *consequent*.

Thus, when we consider one quantity by comparing it with another, to see what magnitude it has in comparison of that other; the magnitude this quantity is found to have in comparison with it, is called the *ratio* of this quantity to that: which some think would be better expressed by the word *comparison*.

Euclid defines ratio by a *mutual relation of two magnitudes of the same kind in respect of quantity*. But this definition is found defective; there being other relations of magnitudes which are constant, yet are not included in the number of ratios: such as that of the right sine, to the sine of the complement in trigonometry.

Hobbes endeavoured to improve Euclid's definition of ratio, but without success: for in defining it, as he does, by the *relation of magnitude to magnitude*, his definition has not only the same defect with Euclid's, in not determining the particular kind of relation; but it has this farther, that it does not express the kind of magnitudes which may have a ratio to one another.

Ratio is frequently confounded, though very improperly, with *proportion*. Proportion, in effect, is an identity or similitude of two ratios.

Thus, if the quantity A be triple the quantity B; the re-

lation of A to B, *i. e.* of 3 to 1, is called the ratio of A to B. If two other quantities, C, D, have the same ratio to one another that A and B have, *i. e.* be triple one another, this equality of ratio constitutes *proportion*; and the four quantities $A : B :: C : D$, are in proportion, or proportional to one another.

So that ratio exists between two terms; proportion requires more.

There is a twofold comparison of numbers: by the first, we find how much they differ, *i. e.* by how many units the antecedent exceeds, or comes short of, the consequent.

This difference is called the *arithmetical ratio*, or exponent of the arithmetical relation or habitude of the two numbers. Thus, if 5 and 7 be compared, their arithmetical ratio is 2.

By the second comparison, we find how oft the antecedent contains, or is contained in, the consequent; *i. e.* as before, what part of the greater is equal to the less.

This ratio, being common to all quantity, may be called ratio in the general, or by way of eminence: but is usually called *geometrical ratio*; because expressed, in geometry, by a line, though it cannot be expressed by any number.

Modern authors distinguish ratio, with regard to quantity in the general, into *rational* and *irrational*.

RATIO, *Rational*, is that which is as one rational number to another; *e. gr.* as 3 to 4.

RATIO, *Irrational*, is that which cannot be expressed by rational numbers.

Suppose, for an illustration, two quantities, A and B; and let A be less than B. If A be subtracted as often as it can be from B, *e. gr.* five times, there will either be left nothing, or something. In the former case, A will be to B, as 1 to 5; that is, A is contained in B five times; or $A = \frac{1}{5} B$. The ratio here, therefore, is *rational*.

In the latter case, either there is some part, which, being subtracted certain times from A, *e. gr.* 3 times, and likewise from B, *e. gr.* 7 times, leaves nothing; or there is no such part: if the former, A will be to B as 3 to 7, or $A = \frac{3}{7} B$; and therefore the ratio, *rational*. If the latter, the ratio of A to B, *i. e.* what part A is of B, cannot be expressed by rational numbers; nor any other way than either by lines, or by infinite approaching series.

The *exponent of a geometrical ratio* is the quotient arising from the division of the antecedent by the consequent. Thus, the exponent of the ratio of 3 to 2, is $1\frac{1}{2}$; that of the ratio of 2 to 3, is $\frac{2}{3}$: for when the less term is the antecedent, the ratio, or rather the exponent, is a proper fraction. Hence the fraction $\frac{3}{4} = 3 \div 4$. If the consequent be unity, the antecedent itself is the exponent of the ratio: thus, the exponent of 4 to 1, is 4. See **EXPONENT**.

If two quantities be compared, without the intervention of a third; either the one is equal to the other, or unequal: hence, the ratio is either of *equality* or *inequality*. If the terms of the ratio be unequal, either the less is referred to the greater, or the greater to the less: that is, either the less to the greater, as a part to the whole, or the greater to the less, as the whole to a part. The ratio, therefore, determines how often the less is contained in the greater, or how often the greater contains the less; *i. e.* to what part of the greater the less is equal.

The following distinctions of ratios are sometimes found in early authors.

The ratio which the greater term has to the less, *e. gr.* 6 to 3, is called the *ratio of the greater inequality*: the ratio which the less term has to the greater, *e. gr.* 3 to 6, is called the *ratio of the lesser inequality*.

This ratio corresponds to quantity in the general, or is admitted

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admitted of by all kinds of quantities, discrete or continued, commensurable or incommensurable: but discrete quantity, or number, does likewise admit of another ratio.

If the less term of a ratio be an aliquot part of the greater, the ratio of the greater inequality is said to be *multiplex*, multiple; and the ratio of the less inequality, *submultiple*.

Particularly, in the first case, if the exponent be 2, the ratio is called *duple*; if 3, *triple*, &c. In the second case, if the exponent be $\frac{1}{2}$, the ratio is called *subduple*; if $\frac{1}{3}$, *subtriple*, &c.

E. gr. 6 to 2 is in a triple ratio; because 6 contains two thrice. On the contrary, 2 to 6 is a subtriple ratio; because 2 is the third part of 6.

If the greater term contains the less once, and over and above an aliquot part of the same; the ratio of the greater inequality is called *superparticularis*, and the ratio of the less *subsuperparticularis*.

Particularly, in the first case, if the exponent be $1\frac{1}{2}$, it is called *sesquialterate*; if $3\frac{1}{2}$, *sesquiterstial*, &c. In the other, if the exponent be $\frac{2}{3}$, the ratio is called *subsesquialterate*; if $\frac{4}{3}$, *subsesquiterstial*, &c.

E. gr. 3 to 2 is in a sesquialterate ratio; 2 to 3 in a subsesquialterate.

If the greater term contains the less once, and over and above several aliquot parts; the ratio of the greater inequality is called *superpartiens*; that of the less inequality is *subsuperpartiens*.

Particularly, in the former case, if the exponent be $1\frac{2}{3}$, the ratio is called *superbipartiens tertias*; if the exponent be $1\frac{3}{4}$, *supertripartiens quartas*; if $1\frac{4}{5}$, *superquadrupartiens septimas*, &c. In the latter case, if the exponent be $\frac{2}{3}$, the ratio is called *subsuperbipartiens tertias*; if $\frac{3}{4}$, *subsupertripartiens quartas*; if $\frac{4}{5}$, *subsuperquadrupartiens septimas*.

E. gr. the ratio of 5 to 3 is *superbipartiens tertias*; that of 3 to 5, *subsuperbipartiens tertias*.

If the greater term contains the less several times, and, besides, some quota part of the same; the ratio of the greater inequality is called *multiplex superparticularis*; and the ratio of the less inequality, *submultiplex subsuperparticularis*.

Particularly, in the former case, if the exponent be $2\frac{1}{2}$, the ratio is called *duple sesquialtera*; if $3\frac{1}{2}$, *triple sesquialtera*, &c. In the latter case, if the exponent be $\frac{2}{3}$, the ratio is called *subduple subsesquialtera*; if $\frac{4}{3}$, *subtriple subsesquialtera*, &c.

E. gr. the ratio of 16 to 5 is *triple sesquiquinta*; that of 4 to 9, *subduple subsesquiquarta*.

Lastly, if the greater term contains the less several times, and several aliquot parts of it besides; the ratio of the greater inequality is called *multiplex superpartiens*; that of the less inequality, *submultiplex subsuperpartiens*.

Particularly, in the former case, if the exponent be 3, the ratio is called *duple superbipartiens tertias*; if $3\frac{1}{2}$, *triple superbiquadrupartiens septimas*, &c. In the latter case, if the exponent be $\frac{2}{3}$, the ratio is called *subduple subsuperbipartiens tertias*; if $\frac{4}{3}$, *subtriple subsuperquadrupartiens septimas*, &c.

E. gr. the ratio of 25 to 7 is *triple superquadrupartiens septimas*; that of 3 to 8, *subduple subsuperbipartiens tertias*.

These are the various kinds of *rational* ratios; the names of which, though they occur but rarely among the modern writers (for in lieu of them they use the smallest terms of the ratios, *e. gr.* for *duple* 2 : 1, for *sesquialterate* 3 : 2); yet are they absolutely necessary to such as converse with the ancient authors.

Clavius observes, that the exponents denominate the ratios of the greater inequality, both in deed and name; but

the ratios of the less inequality, only in deed, not in name: but it is easy finding the name in these, if you divide the denominator of the exponent by the numerator.

E. gr. if the exponent be $\frac{2}{3}$, then $5 : 8 = 1\frac{1}{3}$; whence it appears, the ratio is called *subsupertripartiens quintas*. As to the names of irrational ratios, nobody ever attempted them.

Same, or *identic* ratios, are those whose antecedents have an equal respect to their consequents, *i. e.* whose antecedents divided by their consequents, give equal exponents. And hence may the identity of irrational ratios be conceived.

Hence, first, as oft as the antecedent of one ratio contains its consequent, or whatever part it contains of its consequent, so oft, or such part of the other consequent does the antecedent of the other ratio contain: or, as oft as the antecedent of the one is contained in its consequent, so oft is the antecedent of the other contained in its consequent.

Secondly, if A be to B as C to D; then will $A : B :: C : D$; or $A : B = C : D$. The former of which is the usual manner of representing the identity of ratios, the latter is that of the excellent Wolfius; which has the advantage of the former, in that the middle character, =, which denotes the sameness, is scientific; *i. e.* it expresses the relation of the thing represented, which the other, ::, does not. See CHARACTER.

Two equal ratios, *e. gr.* $B : C = D : E$, we have already observed, constitute a proportion: of two unequal ratios, *e. gr.* $A : B$ and $C : D$, we call $A : B$ the *greater*, if $A : B > C : D$; on the contrary, we call $C : D$ the *lesser*, if $C : D > A : B$.

Hence, we express a greater and less ratio thus: *e. gr.* 6 to 3 has a greater ratio than 5 to 4; for, $6 : 3 (= 2) > 5 : 4 (= 1\frac{1}{4})$. But 3 to 6 has a less ratio than 4 to 5; for $\frac{3}{6} = \frac{1}{2} > \frac{4}{5}$. Compound ratio is that made up of two or more other ratios, which the factum of the antecedents of two or more ratios has to the factum of their consequents. Thus, 6 to 72 is in a ratio compounded of 2 to 6, and 3 to 12.

Particularly if it be compounded of two, it is called a *duplicate* ratio; if of three, a *triplicate*; if of four, *quadruplicate*; and, in the general, *multiplicate*, if it be composed of several similar ratios. Thus 48 : 3 is a duplicate ratio of 4 : 1 and 12 : 3.

RATIO, *Additive*. See ADDITIVE.

RATIO, *Alternate*. See ALTERNATE.

RATIO, *Ordinate*. See ORDINATE.

RATIO *Modularis* and *Modulus*, were terms introduced into use by Cotes, but more modern authors do not use them always in the same sense: according to Cotes, the modulus in logarithms is that number which connects any system of logarithms with the hyperbolic system, or that number by which the hyperbolic number of a logarithm must be multiplied, or by the reciprocal of which it must be divided, in order to transform it to another system; and this modulus is, therefore, always the reciprocal of the hyperbolic logarithm of the radix of that system to which the modulus belongs.

This is what Cotes calls the modulus, to whom we owe the introduction of the term; and the reciprocal of it he calls the *ratio modularis*: but some modern authors, as Lagrange, &c. use the term modulus to denote the ratio modularis of Cotes.

The modulus of the hyperbolic system is 1, this being the reciprocal of the hyperbolic logarithm of 2.71828182, the radix of this system; and the modulus of the common

logarithmic system is .43429448, which is the reciprocal of 2.3025809, the hyperbolic logarithm of 10, the radix of this system.

It is shewn under the article LOGARITHMS, that

$$\log. a = \frac{(a-1) - \frac{1}{2}(a-1)^2 + \frac{1}{3}(a-1)^3, \&c.}{(r-1) - \frac{1}{2}(r-1)^2 + \frac{1}{3}(r-1)^3, \&c.}$$

where r is the radix, and may be assumed at pleasure, and the reciprocal of this whole denominator is called the modulus. In the hyperbolic system the whole denominator is assumed 1, which makes $r = 2.71828182$; and in the common system r is assumed 10, and the whole series becomes $= 2.3025809$, which is the reciprocal of the modulus; and since, in the former case, we have

$$\text{hyp. log. } a = (a-1) - \frac{1}{2}(a-1)^2 + \frac{1}{3}(a-1)^3, \&c.$$

it follows also that in any other

$$\text{hyp. log. } r = (r-1) - \frac{1}{2}(r-1)^2 + \frac{1}{3}(r-1)^3, \&c.$$

whatever be the value of r ; therefore, in every system, the modulus is the reciprocal of hyp. log. of the radix. See LOGARITHMS.

RATIO, *Denominator of a*. See DENOMINATOR.

RATIO, *Properties of*.—1. Ratios similar to the same third are also similar to one another; and those similar to similar, are also similar to one another.

2. If $A : B :: C : D$; then, inversely, $B : A :: D : C$.

3. Similar parts P and p have the same ratio to the wholes T and t ; and if the wholes have the same ratio, the parts are similar.

4. If $A : B :: C : D$; then, alternately, $A : C :: B : D$. And hence, if $B = D$, $A = C$; hence, also, if $A : B :: C : D$; and $A : F :: C : G$; we shall have $B : F :: D : G$. Hence, again, if $A : B :: C : D$; and $F : A :: G : C$; we shall have $F : B :: G : D$.

5. Those things which have the same ratio to the same, or equal things, are equal; and *vice versa*.

6. If you multiply any quantities, as A and B , by the same, or equal quantities; their products D and E will be to each other as A and B .

7. If you divide any quantities, as A and B , by the same or equal quantities, the quotients F and G will be to each other as A and B .

8. The exponent of a compound ratio is equal to the factum of the exponents of the simple ratios.

9. If you divide either the antecedents or the consequents of similar ratios, $A : B$, and $C : D$, by the same E ; in the former case, the quotients F and G will have the same ratio to the consequents B and D ; in the latter, the antecedents A and C will have the same ratio to the quotients H and K .

10. If there be several quantities in the same continued ratio A, B, C, D, E , &c. the first A is to the third C , in a *duplicate* ratio; to the fourth D , in a *triplicate*; to the fifth E , in a *quadruplicate*, &c. ratio of the ratio of the first A , to the second B .

11. If there be any series of quantities in the same ratio, A, B, C, D, E, F , &c. the ratio of the first A to the last F is compounded of the intermediate ratios $A : B, B : C, C : D, D : E, E : F$, &c.

12. Ratios compounded of ratios, of which each is equal to each other, are equal among themselves. Thus the ratios $90 : 3 :: 960 : 32$, compounded of $6 : 3 :: 4 : 2$, and $3 : 1 :: 12 : 4$; and $5 : 1 :: 20 : 4$.

For other properties of similar or equal ratios, see PROPORTION.

RATIOS, *Reduction of*.—It is obvious that there is a variety of cases in which the real ratio of two quantities may be expressed in terms too great to be applied to any useful purpose; of which we have an example in the construction of planetariums, and similar astronomical instruments. The ratios of the times in which the several planets perform their sidereal revolutions, are expressed in very large numbers, far exceeding the number of teeth that can be introduced into the machinery of a planetarium; and it, therefore, becomes necessary to find smaller numbers, which, though they do not express the true ratio, may approximate as near to the truth as the state of the case will admit. Another instance, in which a reduction of the ratio of large numbers to others expressed in lower terms becomes necessary, occurs in the calendar; for, according to the common reckoning, the year is supposed to be 365 days, whereas it is known to be nearly 365 days 6 hours; it, therefore, becomes necessary to have some means of expressing the ratio between the true and the assumed length of the years, in order that, by a proper intercalation, we may preserve an uniformity in the seasons, with reference to the months, as we should otherwise find the shortest day transferred to the middle of June, and the longest to the month of December.

This reduction of ratios is best performed by means of continued FRACTIONS, of which a sketch is given under that article, as also under the article INDETERMINATE ANALYSIS, but which we shall probably treat at greater length in a supplement to the present work, on which account it is not our intention to enter much into the rationale of the theory in this place, but merely to state the rules by which the required reduction is to be performed.

To reduce a ratio expressed in large numbers, to others nearly equivalent, but represented in simpler terms.

Rule 1.—Divide the greater of the two numbers by the less; then the divisor by the remainder, and so on, as in finding the greatest common measure of two numbers, and reserve the several quotients, which may be denoted by a, b, c, d , &c.

2. Write down the several quotients, thus; a, b, c, d, e , &c. from which the series of converging fractions or ratios will be derived as follows; viz. the first fraction will have unity for its numerator, and the first quotient, a , for its denominator; the second will have the second term, b , for its numerator, and for its denominator $ab + 1$; and the numerators of all the succeeding fractions will be found, by multiplying the numerator last obtained, by the succeeding quotient in the above series, and adding to the product the preceding numerator. And the denominators are obtained by precisely the same rule, merely changing the word numerator into denominator.

In this rule we have supposed the ratio to be less than 1, or the numerator less than the denominator; if the denominator be less than the numerator, it must be reversed, making the numerator what we have called the denominator, and the denominator the numerator.

The last fraction of this series will be the same as the original fraction proposed, and the others will be so many approximate or converging fractions, each of which will approach nearer to the original fraction than the preceding one, and nearer than any other fraction whose terms are not expressed by greater numbers. This rule may be exhibited analytically as follows:

Let $\frac{A}{B}$ be the proposed fraction, and a, b, c , &c. the quotients obtained by the divisions as above, then the converging

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verging fractions will be $\frac{1}{a}, \frac{b}{ab+1}, \frac{bc+1}{(ab+1)c+a},$
 $\frac{(bc+1)d+b}{[(ab+1)c+a]d+ab+1},$ &c. which will be found
 to agree with the preceding rule; and these fractions will
 be alternately greater and less than that proposed, which will
 be the last of the series.

Let us illustrate this rule by an example. Required a
 series of converging fractions towards $\frac{314159}{100000}$, which is
 the fraction commonly employed for expressing the ratio of
 the diameter to the circumference of a circle.

Operation by Division.

$$\begin{array}{r}
 100000)314159(3 = a \\
 \underline{300000} \\
 14159)100000(7 = b \\
 \underline{99113} \\
 887)14159(15 = c \\
 \underline{13305} \\
 854)887(1 = d \\
 \underline{854} \\
 33)854(25 = e \\
 \underline{825} \\
 29)33(1 = f \\
 \underline{29} \\
 4)29(7 = g \\
 \underline{28} \\
 1)4(4 = h \\
 \underline{4} \\
 0
 \end{array}$$

Having thus obtained our quotients, the several fractions
 will be easily formed by the preceding rule; thus,

$$\frac{3}{1}, \frac{7}{7}, \frac{15}{106}, \frac{1}{113}, \frac{25}{2931}, \frac{1}{3044}, \frac{7}{2423}, \frac{4}{100000},$$

the last of which is the same as the original fraction. These
 fractions are formed according to the preceding rule, which
 will be understood from one example; thus, the fifth frac-
 tion is formed from the two preceding fractions as follows:

$$\begin{aligned}
 355 \times 25 + 333 &= 9208 \text{ numerator,} \\
 113 \times 25 + 106 &= 2931 \text{ denominator,}
 \end{aligned}$$

and all the others are obtained in the same manner.

Each of these fractions represents an approximate ratio
 towards the original one, and each of them nearer than
 any preceding fraction in the series, and nearer than any
 fraction expressed in less numbers, or than any fraction
 having a less denominator than the succeeding fractions.

Thus, $\frac{3}{1}$ is a nearer approximation than any fraction whose

denominator is less than 3, and $\frac{355}{113}$ nearer than any frac-

tion whose denominator is less than 2931; &c.

Our original fraction exhibited the ratio usually employed

to denote the ratio of the diameter to the circumference
 of a circle, and amongst our approximations we find some
 of those commonly employed by former writers; as 7 to
 22, being that given by Archimedes; 106 to 333, which
 is another ratio formerly used; also 113 to 355, being that
 invented by Peter Metius. Each of these ratios is alter-
 nately too small and too great, to express the ratio of the
 diameter to the circumference of the circle. Thus, 1 to 3
 is too small a ratio, 7 to 22 too great, 106 to 333 too small,
 and 113 to 355 too great; and so on.

We may therefore divide the above series into two distinct
 classes, one of which shall exhibit the ratios all in excess,
 and the other all in defect, which will stand as follows:
viz.

Ratios in defect.

$$\frac{3}{1}, \frac{333}{106}, \frac{9208}{2931}, \frac{76149}{24239}$$

Ratios in excess.

$$\frac{22}{7}, \frac{355}{113}, \frac{9563}{3044}, \frac{314159}{100000}$$

And between every two consecutive fractions we may now
 interpolate as many fractions of the same kind, as is one
 less than the number of units in the quotients from which
 it was formed. If we write the first of the above series,
 with the corresponding quotients above their terms, we
 shall have

$$\begin{array}{cccc}
 15 & 25 & 7 & \\
 \frac{3}{1}, & \frac{333}{106}, & \frac{9208}{2931}, & \frac{76149}{24239}
 \end{array}$$

We may therefore interpolate, between the two first
 fractions, fourteen others, which will possess the same pro-
 perty as the principal fractions above, *viz.* of approxi-
 mating nearer to the true ratio than any other fractions
 expressed in less terms, but all in defect. Between the
 second and third we may interpolate twenty-four fractions:
 and between the third and fourth, six: all of them less
 than the proposed ratio. But if we take the second se-
 ries and their corresponding quotients, they will stand
 thus:

$$\begin{array}{cccc}
 1 & 1 & 1 & 4 \\
 \frac{22}{7}, & \frac{355}{113}, & \frac{9563}{3044}, & \frac{314159}{100000}
 \end{array}$$

which shews, that no fraction can here be interpolated
 either between the first and second, or between the second
 and third; but there may be three interpolated between
 the third and fourth, which will, of course, be all in ex-
 cess. This interpolation is performed as follows: to the
 numerator and denominator of the less fraction add, once,
 twice, three times, &c. the numerator and denominator of
 the principal fraction which interposes between the two,
 which will form the interpolated fractions required. Thus,

because $\frac{76149}{24239}$ is the principal fraction interposed between
 $\frac{9563}{3044}$ and $\frac{314159}{100000}$, the intermediate or interpolated frac-
 tions will be

$$\begin{aligned}
 \frac{9563 + 76149}{3044 + 24239} &= \frac{85712}{27283} \\
 \frac{9563 + 2.76149}{3044 + 2.24239} &= \frac{161861}{51522} \\
 \frac{9563 + 3.76149}{3044 + 3.24239} &= \frac{238010}{75761}
 \end{aligned}$$

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And in the same manner we may interpolate fourteen fractions between $\frac{3}{1}$ and $\frac{333}{106}$; twenty-four between $\frac{333}{106}$ and $\frac{9208}{2931}$; and six between $\frac{9208}{2931}$ and $\frac{16149}{24339}$.

Having thus explained the nature of the operation, we shall enter less into detail in the following example.

Example 2.—According to M de la Caille, the solar year is $365^d 5^h 48^m 49^s$, and consequently longer by $5^h 48^m 49^s$ than the common year of 365 days. If this difference were exactly 6 hours, it would make one day at the end of four common years: but if we wish to know exactly at the end of how many years this difference will produce a certain number of days, we must seek the ratio

between 24^h and $5^h 48^m 49^s$, which we find to be $\frac{86400}{20929}$,

so that at the end of 86400 common years, we must intercalate 20929 days, in order to reduce them to tropical years.

Now as the ratio of 86400 to 20929 is expressed in very high terms, let it be required to find ratios in lower terms, as near this as possible.

For this purpose, we must perform upon these numbers the same operations as in the preceding case; thus:

$$\begin{array}{r}
 20929 \overline{) 86400} (4 = a \\
 \underline{83716} \\
 2684 \overline{) 20929} (7 = b \\
 \underline{18788} \\
 2141 \overline{) 2684} (1 = c \\
 \underline{2141} \\
 543 \overline{) 2141} (3 = d \\
 \underline{1629} \\
 512 \overline{) 543} (1 = e \\
 \underline{512} \\
 31 \overline{) 512} (16 = f \\
 \underline{496} \\
 16 \overline{) 31} (1 = g \\
 \underline{16} \\
 15 \overline{) 16} (1 = h \\
 \underline{15} \\
 1 \overline{) 15} (15 \\
 \underline{15}
 \end{array}$$

From which quotients we derive the following converging fractions, viz.

$$\frac{4}{1}, \frac{29}{7}, \frac{33}{8}, \frac{128}{31}, \frac{161}{39}, \frac{2704}{655}, \frac{2865}{694}, \frac{5569}{1349}, \frac{86400}{20929}.$$

Now we see from the above fractions, that the simplest intercalation is that of one day in four common years, which is the foundation of the Julian calendar; but that we should approximate with more exactness, by intercalating only 7 days in the space of 29 common years, or 8 in the space of 33 years, and so on.

It appears farther, that as the fractions $\frac{4}{1}, \frac{29}{7}, \frac{33}{8}, \&c.$ are alternately less and greater than the fraction $\frac{86400}{20929}$, or

$\frac{24^h}{5^h 48^m 49^s}$, the intercalation of 1 day in 4 years would be too much, of 7 days in 29 years too little, of 8 days in 33 years too much again, and so on; but each of these intercalations will be the most exact, that it is possible to make in the same space of time.

Now if we arrange in two separate series, the fractions that are less, and those that are greater, than the given fractions, we may insert or interpolate between certain of those fractions, as in the preceding examples.

Taking first those fractions that are less than the given one, and their corresponding quotients, we shall have,

$$\frac{1}{4}, \frac{1}{33}, \frac{15}{2865}, \frac{15}{86400}.$$

Hence it appears, that the only interpolation that can be performed is between the two fractions $\frac{2865}{694}$ and $\frac{86400}{20929}$;

which will admit of 14 intermediate fractions; which being supplied, as in the former example, gives the following series of converging fractions, each less than the fraction originally proposed, viz.

$$\begin{array}{r}
 \frac{4}{1}, \frac{33}{8}, \frac{161}{39}, \frac{2865}{694}, \frac{8434}{2043}, \frac{14003}{3392}, \\
 \frac{19572}{4741}, \frac{25141}{6090}, \frac{30710}{7439}, \frac{36279}{8788}, \\
 \frac{41848}{10137}, \frac{52986}{12835}, \frac{58555}{14184}, \frac{64124}{15533}, \\
 \frac{69633}{16882}, \frac{75262}{18231}, \frac{80831}{19580}, \frac{86400}{20929}.
 \end{array}$$

And as the last fraction is the same as the given fraction, it is evident that this series cannot be carried farther: hence, if we choose to admit these intercalations only in which the error is too much, the simplest and most exact will be those of 1 day in 4 years, or of 8 days in 33 years, or of 39 in 161 years, and so on.

Let us now consider the decreasing fractions:

$$\frac{7}{29}, \frac{3}{128}, \frac{16}{2704}, \frac{1}{5569}.$$

Here it appears, that we may place 6 fractions before the first, 2 between the first and second, 15 between the second and third; but between the third and fourth no such fraction can be inserted.

These interpolations being made, we shall have the following series of decreasing fractions, viz.

$$\begin{array}{r}
 \frac{5}{1}, \frac{9}{2}, \frac{13}{3}, \frac{17}{4}, \frac{21}{5}, \frac{25}{6}, \\
 \frac{29}{7}, \frac{62}{15}, \frac{95}{23}, \frac{128}{31}, \frac{289}{70}, \frac{450}{109}, \\
 \frac{611}{148}, \frac{772}{187}, \frac{933}{226}, \frac{1094}{265}, \frac{1255}{304},
 \end{array}$$

$$\begin{array}{cccccc} 1416 & 1577 & 1738 & 1899 & 2060 & \\ 343 & 382 & 421 & 460 & 499 & \\ 2221 & 2382 & 2543 & 2704 & 2865 & \\ 538 & 577 & 616 & 655 & 694 & \end{array}$$

which are all less than the proposed fraction, and expressed in less terms; and each of which is nearer than any other fraction that can be expressed in less terms.

Hence we conclude, that if we only attend to the intercalations in which the error is too small, the simplest and most exact are those of 1 day in 5 years, of 2 days in 9 years, of 3 days in 13 years, of 4 days in 17 years, and to on.

In the Gregorian calendar, only 97 days are intercalated in 400 years; but it is evident, from the preceding table, that it would be much more exact to intercalate 109 days in 450 years.

But it must be observed, that in the Gregorian reformation, the determination of the year given by Copernicus was made use of, which is $365^d 5^h 49' 20''$; and substituting

this instead of the fraction $\frac{86400}{20929}$, we shall have $\frac{86400}{29060}$, or

rather $\frac{540}{131}$; whence we may find, by the preceding method, the quotients 4, 8, 5, 3; and from them the principal fractions

$$\begin{array}{cccc} 4 & 8 & 5 & 3 \\ \frac{4}{1}, & \frac{33}{8}, & \frac{169}{41}, & \frac{540}{131}; \end{array}$$

which, except the two first, are quite different from those before determined. However, we do not find amongst

these fractions $\frac{400}{97}$, which is that adopted in the Gregorian

calendar; and this fraction cannot even be found among the interpolated fractions, which might be inserted in the two

series, $\frac{4}{1}, \frac{169}{41}$, and $\frac{33}{8}, \frac{540}{131}$: for it is evident that it

could only be between the last two fractions, between which, because of the number 3, (the corresponding quotient,) there can be but two fractions interpolated, which

are $\frac{202}{49}$, and $\frac{371}{90}$: whence it appears, that it would have

been more exact, if, in the Gregorian reformation, they had only intercalated 90 days in the space of 371 years.

If we reduce the fraction $\frac{400}{37}$, so as to have for its

numerator the number 86400, it will become $\frac{86400}{20952}$, which

estimates the tropical year at $365^d 5^h 49' 12''$.

In this case, the Gregorian intercalation would be quite exact; but as observations shew that the year is shorter than this by more than $20''$, it is evident that, at the end of a certain period of time, we must introduce a new intercalation.

If we adopt the determination of de la Caille, it follows, as the denominator 97 of the above fraction, viz. $\frac{400}{97}$, lies between the denominators of the fifth and sixth principal

fractions already found, that, from what has been stated above, the fraction $\frac{161}{39}$ will be nearer the truth than

$\frac{400}{97}$. But as astronomers are still divided with regard to

the exact length of the year, we shall refrain from giving a decisive opinion on this subject. For more on the reduction of ratios, see Lagrange's Additions to Euler's Elements of Algebra.

RATIOS, *Prime and Ultimate*, is a species of computation, which we owe to the fertile genius of Newton. The ancients, in order to extend the geometry of right lines to curvilinear figures, had recourse to the method of *exhaustions*, in which they made use of what is called the *reductio ad absurdum* method, which, though logical, is extremely tedious, and to avoid which, Cavalierius proposed his method of *indivisibles*, published in 1635 under the title of "*Geometria Indivisibilibus*," in which he was followed by Dr. Wallis and others of the 17th and 18th centuries. In this method every line was supposed to consist of a number of other lines indefinitely small; every curve was considered as a polygon of an indefinite number of sides, each side being indefinitely small; a solid was supposed to consist of an infinite number of plane sections, or of indefinitely thin laminæ, and so on; suppositions which in many instances led those, who adopted them, into errors and inconsistencies, which indeed it was very difficult to avoid.

To obviate both the tediousness of the ancients, and the inaccuracy of the moderns, Newton introduced his method of *prime and ultimate ratios*, the foundation of which is contained in the first lemma of the first book of his "*Principia*." Many difficulties have been started, and much controversy concerning the proof of it; all of which would have been avoided, had either the author or his readers observed, that he is in reality laying down the definition of a term, viz. *being ultimately equal*, and not proving a proposition. Taking, therefore, this first lemma for a definition, it may be illustrated as follows.

Let there be two quantities, one fixed and the other varying, so related to each other, that, 1st, the varying quantity continually approaches to the fixed quantity; and, 2dly, that the varying quantity never reaches or passes beyond that which is fixed: 3dly, that the varying quantity approaches nearer to the fixed quantity than by any assigned difference. Then is such a fixed quantity called the *limit* of the varying quantity; or, in other words, the varying quantity may be said to be *ultimately equal* to the fixed quantity. These three conditions may be expressed more distinctly thus. 1. The difference between the varying quantity and the fixed quantity must continually decrease. 2. This difference must never become either nothing or negative. 3. This difference must become less, in respect of the fixed quantity, than by any assigned ratio; or the difference between the two quantities must become a less part of the fixed quantity than any fractional part that is assigned, however small the fraction expressing such part may be. Wherever these properties are found, the fixed quantity is called the *limit* of the varying quantity, or the varying quantity is said to be *ultimately equal* to the fixed quantity. The last expression, however, must not be understood in its strict literal sense, there being no *ultimate state*, no particular magnitude, that is the *ultimate magnitude* of such a varying quantity. Under the word quantity in this definition, must be included not only numbers, lines, &c., but more especially ratios considered as a peculiar species of quantity; but as the con-

RATIO.

consideration of ratios which have limits is difficult, we shall begin with examples of other quantities.

1st. Let there be formed a series, whose first term is 1; second, $\frac{1}{2}$; third, $\frac{1}{4}$; fourth, $\frac{1}{8}$, and so on; every term being half the preceding one, *viz.*

$$1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}, \&c.$$

and let the sum of an indefinite number of terms in this series be considered as continually increased by the accession of a new term; thus, the sum of the two first is $1\frac{1}{2}$, of three terms is $1\frac{3}{4}$, of four terms is $1\frac{7}{8}$, &c. I say then, that the varying sum of the terms of this series continually approximates to the fixed number 2, as its limit. For the difference between 1, 2, 3, &c. terms and the number 2, will be the

numbers $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \&c.$ successively, in in-

finity. Here it is evident, that the terms in this last series, which express the successive differences between the increasing sum of the former series and the number 2, first, continually decrease; and secondly, no term in this series of differences can become either nothing or negative; and thirdly, we may continue this series of successive differences, till we arrive at a term which shall be a less part of the fixed number 2, than any fractional part of it that can be assigned; or so that this difference shall be less, when compared with the number 2, than any ratio assigned. The number 2, therefore, having the conditions laid down in the definition, is to be called the limit of the sum of the terms of the

infinite series $1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \&c.$

And the same is to be understood of any other infinite series; *viz.* if a number can be found having the above conditions, that series is said to have a limit; and the finding of this limit, is what is to be understood when mathematicians speak of finding the sum of such an infinite series.

No number less than 2, for instance $1\frac{1}{4}$, can be taken for the limit; for, in this case, it will not answer the second condition of the definition. In the above example, the sum of four terms of the series is equal to $1\frac{7}{8}$, and the sum of five terms exceeds it; therefore, the difference between this sum and the number $1\frac{1}{4}$ proposed as a limit is, in the former case zero, and in the latter negative. Neither can any number greater than 2, as for example 3, be taken for the limit, because here the last condition will be wanting; for if the sum of any assigned number of terms be less than 2, that sum must always want more than unity of the number 3, and consequently cannot approach nearer to 3, than any assigned quantity, as 1.

In like manner the sum of the series $1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \&c.$ continued in infinity, will be $1\frac{1}{2}$; the series of successive differences being $\frac{1}{2}, \frac{1}{6}, \frac{1}{18}, \frac{1}{54}, \&c.$ in infinity.

Now, in order to make the preceding example general, let $a:b$ express the common ratio of any series of numbers in continual proportion, whose first term is unity, I say then, if a be greater than b , such a series will have for its

limit the quantity $\frac{a}{a-b}$; or, in other words, the sum of all the terms of such an infinite series will be $\frac{a}{a-b}$.

For the terms of this series will be $1, \frac{b}{a}, \frac{b^2}{a^2}, \frac{b^3}{a^3}, \&c.$

Whence the sum of 1 term is 1
of 2 terms $1 + \frac{b}{a}$
of 3 terms $1 + \frac{b}{a} + \frac{b^2}{a^2}$
of 4 terms $1 + \frac{b}{a} + \frac{b^2}{a^2} + \frac{b^3}{a^3}$

Let each of these sums be subtracted from the limit $\frac{a}{a-b}$, and we have the successive differences $\left(\frac{b}{a-b}\right), \left(\frac{b}{a-b} \cdot \frac{b}{a}\right), \left(\frac{b}{a-b} \cdot \frac{b^2}{a^2}\right), \left(\frac{b}{a-b} \cdot \frac{b^3}{a^3}\right), \&c.$ or if n be any assigned number of terms, the difference between the sum of that number of terms and the limit $\frac{a}{a-b}$, will be $\frac{b}{a-b} \cdot \frac{b^{n-1}}{a^{n-1}}$. Whence we may observe, 1st, that as the number of terms whose sum is required increases, this difference continually decreases, because $\frac{b}{a}$, being a fraction less than unity, its powers continually decrease. 2dly. This difference can never become nothing or negative; the powers of a fraction, though they decrease, being always real and affirmative. 3dly. This difference may become less in respect of $\frac{a}{a-b}$, than by any assigned ratio.

For $\frac{a}{a-b} : \frac{b}{a-b} \cdot \frac{b^{n-1}}{a^{n-1}}$ as $a^n : b^n$; or as $\frac{a^n}{b^n}$ to 1; or as $\left(\frac{a}{b}\right)^n$ to 1: and since $\frac{a}{b}$ is greater than 1, and n inde-

terminate, the former term of the ratio may become greater than any assigned quantity, and therefore the ratio itself less than any ratio assigned.

The quantity $\frac{a}{a-b}$, having, therefore, the required conditions, is the limit of the above series, or is equal to the sum of all the terms continued in infinity.

What has been proved above may be shewn more concisely by dividing a by $a-b$, in the manner of division in algebra, for the quotients will be the very series proposed in the example: for instance,

$$\begin{array}{r} a-b \overline{) a} \quad \frac{a}{a-b} \left(1 + \frac{b}{a} + \frac{b^2}{a^2} + \frac{b^3}{a^3} + \&c. \right. \\ \underline{a-b} \\ b \\ \underline{b-b} \\ 0 \\ \underline{b^2} \\ b^2 \\ \underline{b^2-b^2} \\ 0 \\ \underline{b^3} \\ b^3 \\ \underline{b^3-b^3} \\ 0 \\ \underline{b^4} \\ b^4 \\ \underline{b^4-b^4} \\ 0 \end{array}$$

And

And it may be further confirmed by multiplying the proposed series by $a - b$, for the product will be a , all the terms except the first destroying each other.

We may also observe, that if every term of the foregoing series be multiplied by any number c , it will become $c +$

$$\frac{bc}{a} + \frac{b^2c}{a^2} + \frac{b^3c}{a^3} + \&c.; \text{ a series having the same ratio,}$$

but whose first term is c ; and it is therefore evident, that, in this case, to find the sum of all the terms, we must multiply

$$\text{the former limit by } c, \text{ whence it will become } \frac{ac}{a-b}.$$

Before we begin to consider ratios, it may not be amiss to caution the reader against confounding the terms of a ratio with the ratio itself: the terms of a ratio may vary in some cases through all degrees of magnitude, and yet the ratio remain constant or invariable. In other instances, varying the terms *in infinitum*, likewise varies the ratio *in infinitum*; while in others, though varying the terms may also vary the ratio, yet the last ratio can never exceed certain limits.

Let x be any varying quantity; make $4x^2 + 3x = A$, and $2x^2 + x = B$, then will A and B also be varying quantities, as depending upon x ; when x vanishes, A and B will both vanish; when x is infinite, they will be both infinite. I say then the ratio of A to B , while x decreases *in infinitum*, approximates to the ratio of 3 to 1.

For, first, A is to B , as $4x^2 + 3x$ is to $2x^2 + x$, or as $4x + 3$ to $2x + 1$; where it is obvious, that as x decreases, the quantities $4x$ and $2x$ also decrease, and consequently the ratio of $4x + 3$ to $2x + 1$, or of A to B , approaches to that of 3 to 1. Secondly, the ratio of A to B can never exceed 3 to 1. For $6x + 3x$ is to $2x^2 + x$, as 3 to 1; but $4x^2 + 3x$ is a less quantity than $6x^2 + 3x$, therefore $4x^2 + 3x$ is to $2x^2 + x$, or A is to B in a less ratio than $6x^2 + 3x$ to $2x^2 + x$; that is, less than the ratio of 3 to 1. Lastly, the ratio of A to B will approach nearer to the ratio of 3 to 1, than any assigned difference. For in the terms of this ratio, $4x + 3$ to $2x + 1$, the varying parts $4x$ and $2x$, by diminishing x , may become less than any assigned quantity, while the other parts, 3 and 1, remain the same; therefore the ratio of A to B will approach nearer to the ratio of 3 to 1, than by any assigned difference.

In like manner the ratio of A to B , while x increases *in infinitum*, approximates to the ratio of 2 to 1, as its limit.

For since A is to B as $4x + 3$ to $2x + 1$, or as $4x + \frac{3}{x}$

to $2 + \frac{1}{x}$, it is obvious, that as x increases, the quantities

$\frac{3}{x}$ and $\frac{1}{x}$ decrease, and consequently the ratio of $4 + \frac{3}{x}$

to $2 + \frac{1}{x}$, or of A to B , approaches to the ratio of 4 to 2,

or of 2 to 1. For $4x^2 + 2x$ is to $2x^2 + x$, as 2 is to 1; but $4x^2 + 3x$ is a greater quantity than $4x^2 + 2x$, therefore $4x^2 + 3x$ is to $2x^2 + x$, or A is to B always in a greater ratio than 2 to 1. Lastly, the ratio of A to B will approach nearer to that of 2 to 1, than by any assigned

difference. For in the terms of this ratio, $4 + \frac{3}{x}$ and $2 + \frac{1}{x}$,

the variable parts $\frac{3}{x}$ and $\frac{1}{x}$, by increasing x , may become

less than any assigned fraction, while the parts 4 and 2 remain the same; therefore the ratio of A to B will approach nearer

to the ratio of 4 to 2, or 2 to 1, than the assigned difference. Hence then we see that though diminishing x , and consequently diminishing the terms A and B , we increase their ratio, and on the contrary increasing these terms, by increasing the quantity x , we decrease their ratio, yet there is a limit both to the increase and decrease of this ratio, although there be none to the terms themselves which compose it.

The ratio of 3 to 1, which limits the ratio of A to B , when these terms decrease *in infinitum*, is called the *ultimate ratio* of the evanescent quantities A and B . The ratio of 2 to 1, which is their other limit, is called the *ultimate ratio* of the quantities A and B increasing *in infinitum*.

Another example of a similar kind we have as follows. Let x be a varying quantity, and d a constant one, then will $x + d$ and x be two varying quantities capable of all degrees of magnitude, I say that the ratio of $x + d$ to x , while x increases, will continually decrease, but not beyond a certain limit, which is the limit of equality. On the contrary, if x decrease, the ratio of $x + d$ to x will continually decrease more and more *ad infinitum*, and never

come to a limit. For $x + d$ is to x , as $1 + \frac{d}{x}$ to 1; now

as x increases, the fraction $\frac{d}{x}$ decreases, and may become

less than any assigned fraction; but the number 1, which is the other part of the antecedent of this ratio, remains the same, as does likewise the consequent, therefore the

ratio of $1 + \frac{d}{x}$ to 1, continually approximates to a

ratio of equality. Secondly, it can never reach that ratio,

because $\frac{d}{x}$ has always some magnitude, and consequently

$1 + \frac{d}{x}$ always greater than 1. It therefore can never reach

the ratio of equality, and much less can it pass it, so as to become a ratio *minoris inaequalitatis*, or a ratio in which the antecedent is less than the consequent. Lastly, the varying

fraction $\frac{d}{x}$, as x increases, will become less than any assigned

fraction, while the other part of the antecedent, and likewise the consequent of this ratio, remain the same. There-

fore the ratio of $1 + \frac{d}{x}$ to 1, will approach nearer to the

ratio of equality, than by any ratio that can be assigned, however small such ratio may be; therefore the ratio of

equality is the limit of the ratio of $1 + \frac{d}{x}$ to 1, and

consequently the limit of the ratio of $x + d$ to x , which continually decreases, while the terms which compose this ratio continually increase *in infinitum*.

If x decrease then $\frac{d}{x}$ will increase, and may become greater

than any assigned number, while the other part of the antecedent, and likewise the consequent, remain invariable;

therefore the ratio of $1 + \frac{d}{x}$ to 1, and consequently the

ratio of $x + d$ to x , as x decreases, will become greater than any assigned ratio whatever, having no limit to its increase.

We may farther observe, that though the terms of this ratio, *viz.* $x + d$ to x , never approximate nearer to each other, their constant difference being d , yet the ratio of the terms approximates to the ratio of equality; that is, though the terms get no nearer in their difference, yet, if we may be allowed the expression, they get nearer in their ratio. The difference of the terms, and the ratio of the terms, are ideas very distinct from each other, and in no wise to be so connected, but that one may vary whilst the other is constant. Although the ratio of equality may strictly be called the *limit of the varying ratio* of the quantities $x + d$ and x , yet the terms of this ratio can never be strictly said to be equal, nor *ultimately equal*, as that supposes an ultimate state in which they are equal; nor equal when they *vanish into infinity*, or, when they pass out of finity into infinity. There is no finite quantity next to infinity, no number, for instance, which is the next number to infinity. Nor is there any step from a state of *nothingness* into finite existence; there is no fraction so small as to be the very next fraction to nothing; no fraction can be assigned so small, but another fraction may be assigned that is smaller. Neither can we say, in strictness, that two infinitely great numbers with a finite difference are equal, it being a proposition obviously absurd and contradictory. There is no such thing in nature as an infinitely great number; and it is contradictory to say of any two numbers, both that they have a difference, and that they are equal. Whoever considers that the idea of infinity is a general or abstract idea, that the idea of number is always particular, that infinity is a *property* of numbers, a *property* of extension, &c. itself, will readily perceive that these and such like expressions have no literal meaning. (See Locke, b. ii. ch. 16. and ch. 17.) As to the metaphorical use of them, to avoid circumlocution, or the introduction of new terms, it may be allowed, when once the literal meaning has been explained, in this, as well as on various other occasions both in science and in common life.

When the difference between any two quantities decreases, so as to become a less fractional part of the one of them than any assigned fractional part whatever; or when the difference between the terms of a ratio becomes less in respect of one of them (the greater for example) than any assigned ratio, this may be expressed by saying, that such difference *vanishes* in respect of that *greater* quantity.

But if the difference between two terms vanish in respect to one of them, it will also vanish in respect of the other. It is true that at any assigned time, when the terms have a particular magnitude, the difference between the terms will always be a less fractional part of the greater term than it is of the less term; but as this difference continually decreases, it will become the same fractional part of the less term that it was before of the greater, however small that fractional part of the greater term may be; therefore, if the difference vanish with regard to one of them, it will vanish also with regard to the other. We may, therefore, instead of the third condition of our definition, say, that "the difference must vanish in respect either of the fixed or of the varying quantity, since one of these implies the other."

The above is true as well for the case of two variables, as for one fixed and one variable, though both of such variables increase or decrease without limit. Thus, in the example above given, in which the terms were $x + d$ and x , and where x is continually increasing, the terms themselves both continually increase; for in this instance it is obvious, that if the difference vanish with respect to one of the terms, it will also vanish with respect to the other. Let x be to d , at any assigned point of time, as n is to 1, and d at that instant of

time will be the $\frac{1}{n+1}$ -th part of the greater term, and the

$\frac{1}{n}$ -th part of the less term: now, though the contemporary value of these fractions can never be equal, yet in succession the value of the latter fraction will become whatever the former has been; therefore, if $\frac{1}{n+1}$ become less than any as-

signed fraction, so will $\frac{1}{n}$ likewise; and thus, if the difference

vanishes with respect to one of the terms, $x + d$, so will it also vanish with respect of the other, x . And the same would be true if the terms were x and $x - d$, all things else being as before.

Again, if x by decreasing vanish with respect to some fixed quantity n , then will x , multiplied by a given number n , or $n x$, vanish in respect of a ; or, which is the same, if x vanish in respect of a , so likewise will the quantity $n x$; bearing to x the assigned ratio of n to 1. For though at any particular point of time x is a smaller fractional part of a than $n x$, yet x can be no assigned fractional part of a whatever; but by farther diminishing x , the quantity $n x$ may become the same fractional part of a that x was before. If, then, x may become equal to, or less than, any assigned fractional part of a , so likewise may $n x$; that is, if x vanish in respect of a , so likewise will $n x$.

For a like reason, if x vanish in respect of any quantity, it will likewise vanish in respect to that quantity multiplied or divided by any number; or it will vanish in respect of a quantity, bearing to a any assigned ratio, as that of m to 1. Thus, if x vanish in respect of a , it will also vanish in respect of $3 a$, $2 a$, $\frac{1}{2} a$, &c. Or, if any fraction vanish in respect to the diameter of a circle, it will likewise vanish in respect of the radius. For whatever part of the diameter the line x may be at any assigned point of time, let x farther decrease, till it be half what it was at that assigned time, and it will now be the same part of the radius that it was before of the diameter; and the same with various other lines and quantities. We have shewn, in the preceding part of this article, that the ratio which two quantities bear to each other may have a limit, although the terms themselves may increase or decrease perpetually without limit. 1. If the terms approximate towards each other; 2. if the less never pass the greater; and, lastly, if their difference vanish in respect of either term, then the limit of their varying ratio is that of equality: and this, whether the terms themselves are such, as by increasing they both become greater than any assigned quantity, or, which is more common, such as by decreasing become less than any assigned quantity, or as it is called, *infinitely small*. Because the idea of the terms of a ratio is less abstract than that of the ratio itself, it is more usual to say that the terms themselves in this case are ultimately equal, though, strictly, it is the ratio only of the terms that comes to a limit, for the terms themselves are supposed to increase or decrease without limit, or as we commonly say, *ad infinitum*.

Prop.—In a circle whose centre is C, (Plate XIII. Analysis, fig. 9.) radius CA, diameter Aa, let AB be the chord, FB the sine, and AD the tangent of the arc AB. I say, that while the arc AB continually decreases without limit; 1st, the sine continually approximates to the tangent; 2dly, the sine never exceeds the tangent; 3dly, the difference will vanish in respect of either sine or tangent.

First; BF : DA :: CF : CA, but while the arc decreases, CF approximates to CA; BF approximates to DA.

D A. 2dly. C F can never exceed C A; therefore B F can never exceed D A. 3dly. The arc continually decreasing without limit, vanishes in respect of the diameter, which is fixed; therefore the chord A B, which is less than the arc, likewise vanishes in respect of the diameter A a. But $A a : A B :: A B : A F$; therefore, if A B vanishes in respect of A a, A F will vanish in respect of A B; and much more will A F vanish in respect of A a; but if A F vanish in respect of A a, it will also vanish in respect of $\frac{1}{2}$ A a, or C A.

Now $C A : C F :: A D : F B$, and by division of proportion $C A : A F :: A D : A D - F B$. Therefore, as A F vanishes in respect of C A, so does $A D - F B$ (the difference of the fine and tangent) vanish in respect to A D the tangent, and consequently in respect of F B the fine. Whence we see, that while the arc continually decreases without limit, the fine approximates to the tangent; 2dly, the fine never exceeds the tangent; 3dly, although the fine and tangent both vanish in respect of the radius, yet their difference vanish in respect of these quantities themselves. Therefore the ratio of equality is the limit of the varying ratio which the fine and tangent have to each other, while they both decrease perpetually without limit, or it is their *ultimate ratio*, or, as we may say, they are *ultimately equal*. The fine is less than the chord; for in the right-angled triangle A F B, the side B F is less than the hypotenuse A B; the chord is less than the arc; this is self-evident, the chord being a straight line, and the arc a curve, both terminated by the same points A and B. The arc is less than the tangent; for from the point D draw another tangent to the circle in H; and the lines A B H, A D H, will be terminated by the same points A and H; and will have the concavities turned the same way; therefore the included arc A B H will be less than the sum of the two equal tangents D A and D H; consequently half that arc, or A B, will be less than half the sum of the tangents A D.

Cor. 1.—Hence the fine, chord, arc, and tangent, are all ultimately in a ratio of equality. This may appear because the chord and arc are included between the fine and tangent, but perhaps more plainly thus. Of these four quantities, *viz.* the fine, chord, arc, and tangent, the fine is the least, and the tangent the greatest; therefore, the difference between the fine and the tangent is greater than the difference between any other two of these four quantities. If, therefore, the greatest of all those differences vanish in respect of the least of all those quantities, much more will the difference between any other two of these four quantities vanish in respect of the quantities themselves.

Cor. 2.—Join B a, and in the right-angled triangle B F a, the hypotenuse B a is greater than the side F a; therefore $A a - B a$ is less than $A a - F a$, or than A F; but while the arc A B decreases continually without limit, A F vanishes in respect of A a; much more then does $A a - B a$, the difference A a and B a, vanish in respect of A a; therefore the ultimate ratio of A a to B a is that of equality; and the ultimate ratio of $\frac{1}{2}$ A a, or B C to B A, is that of 2 to 1. See other applications of these principles in Ludlam's "Rudiments of Mathematics," from which the preceding article has been abstracted; Newton's "Principia," lib. i.; Smith's "Fluxions;" and Saunderson's "Algebra."

RATIO, in our *Law Writers*, is used for a judgment given in a cause.

Hence, *ponere ad rationem* is to cite one to appear in judgment. Wallingh. 88.

RATIO Status, *Razione di Stato*. See **REASON of State**.

VOL. XXIX.

RATIO *Vidus*. See **VICTUS**.

RATIOCINATION, the act of reasoning.

RATION, or **RATIAN**, in the *Army*, a pittance or proportion of ammunition, bread, drink, or forage, distributed to each soldier for his daily subsistence.

Some write the word *racion*, and borrow it from the Spanish *racion*; but they both come from the Latin *ratio*. In some parts they call it a *reason*.

The horse have rations of hay and oats, when they cannot go out to forrage. See **FORRAGE**.

The rations of bread are regulated by weight. The ordinary ration of a foot soldier is a pound and a half of bread *per day*. The officers have several rations, according to their quality, and the number of attendants that they are obliged to keep.

When the ration is augmented on occasions of rejoicing, it is called a *double ration*.

The ships' crews have also their rations or allowances of biscuit, water, &c. proportioned according to their flock. The usual ration at sea, particularly among the Portuguese, &c. is a pound and half of biscuit, a pint of wine, and a quart of fresh water *per day*; and each month an arrobe, or thirty-one pounds of salt meat, with some dried fish and onions.

RATIONABILES EXPENSÆ, *Reasonable Expenses*. The commons in parliament, as well as the proctors of the clergy in convocation, were anciently allowed *rationabiles expensas*; that is, such allowance as the king, considering the prices of all things, shall judge meet to impose on the people to pay for the subsistence of their representatives.

This in the 17th of Edward II. was settled at ten groats *per day* for knights, and five for burgesses: afterwards, four shillings a day for knights, and two shillings for burgesses; which was then deemed an ample retribution, both for expences, for labour, attendance, neglect of their own affairs, &c. See **BURGESS**, and **KNIGHTS of the Shire**.

RATIONABILI Parte Bonorum, a writ which lies for the wife, against the executors of her husband, denying her the third part of her husband's goods, after debts and funeral expences paid.

Fitzherbert quotes Magna Charta, and Glanville, to prove, that, by the common law of England, the goods of the deceased, his debts first paid, should be divided into three parts; of which his wife is to have one, his children a second, and the executors a third; adding, that this writ lies as well for the children, &c. as the wife. Such is the general law of Scotland at this day. And whatever may have been the custom of late years, in many parts of the kingdom, or however it was introduced in derogation of the old common law, the ancient method continued in use in the province of York, the principality of Wales, and the city of London, till very modern times; when in order to favour the power of bequeathing, and to reduce the whole kingdom to the same standard, three statutes have been provided; the one 4 & 5 W. & M. c. 2. explained by 2 & 3 Ann. c. 5, for the province of York; another, 7 & 8 W. III. c. 38. for Wales; and a third, 11 Geo. I. c. 18. for London (see *CUSTOM of London*); whereby it is enacted, that persons within those districts, and liable to those customs, may, if they think proper, dispose of all their personal estates by will; and the claims of the widow, children, and other relations, to the contrary, are totally barred. Thus is the old common law now utterly abolished throughout all the kingdom of England, and a man may devise the whole of his chattels as freely as he formerly could his third part or moiety. Blackst. Com. b. ii.

Recto de RATIONABILI Parte. See **RECTO**.

RATIONABILIBUS DIVISIS, is a writ that lies where two lords have signories joining together, for him that finds his waste encroached upon, within the memory of man, against the encroacher, thereby to rectify the bounds of the signories: in which respect, Fitzherbert says, it is of the nature of a writ of right.

RATIONABILIS DOS, a third part of such lands and tenements as the husband was seized of at the time of the espousals, with which his wife was formerly endowed by the common law, if no specific dotation was made at the church porch. See **DOWER** and **JOINTURE**.

RATIONAL, REASONABLE. See **REASON**.

RATIONAL Fable. See **FABLE**.

RATIONAL Fractions, in *Arithmetic* and *Analysis*, are those fractions into which no surd or radical quantity enters; as $\frac{7}{8}, \frac{19}{27}, \frac{x^2 + 1}{x^3 + 1}, \frac{x^3 + x^2 + ax}{x^3 + bx^2 + cx}$, &c.

The decomposition of rational fractions into simple fractions, that is, the decomposition of them into other fractions whose sum is equal to that proposed, is an important problem, as connected with the integral calculus, or inverse method of fluxions, which was first investigated by Leibnitz, but has since been much extended and simplified by the researches of Euler, La Grange, La Croix, and other eminent analysts.

The decomposition of numeral fractions into their partial fractions, is, perhaps, rather a subject of curiosity than utility, yet as connected with, and leading to, the decomposition of rational algebraic fractions, it may not be amiss to give here a sketch of the process by which it is accomplished, previous to entering upon the latter subject.

On the decomposition of rational numeral fractions, into others having prime denominators.

It is to be observed, that this can only be effected in the case of a composite denominator, or rather, there will be no difficulty in any other case, as it will require only a separation of the numerator into any parts at pleasure, the sum of which is obviously equal to the fraction proposed; we shall therefore only consider those fractions having composite denominators, which are to be resolved into others having prime denominators; and even in this case there may be fractions that will not admit of decomposition, as will appear from what follows. This decomposition is effected, when possible, by

means of the indeterminate analysis; viz. let $\frac{m}{n}$ be the given

fraction, and suppose, in the first instance, that its denominator consists of two prime factors, or $n = ab$, it will then

be to find $\frac{m}{ab} = \frac{p}{a} + \frac{q}{b}$, or $aq + bp = m$; p and q

being the required numerators of the two partial fractions, and which values of p and q are easily found from the above equation $aq + bp = m$, on the principles explained under the article **INDETERMINATE Analysis**, subject however to the same limitation there mentioned; viz. the above equation is always possible, provided $m > ab - a - b$, but in other cases it may or may not admit of solution.

If the given fraction be $\frac{m}{abc}$, then we may first

resolve it into two fractions, and one of these into

two others; thus, let $\frac{m}{abc} = \frac{p}{ab} + \frac{q}{c}$, then we have

$abq + cp = m$, from which equation p and q may be found.

Again, let $\frac{p}{ab} = \frac{r}{a} + \frac{s}{b}$, which gives $as + rb = p$,

whence r and s may be determined, and we shall thus obtain

$\frac{m}{abc} = \frac{r}{a} + \frac{s}{b} + \frac{q}{c}$, as required. In all these cases

it is obvious, that the fraction may be decomposed into partial fractions, in as many different ways as the indeterminate equation on which it depends admits of different answers.

Example.—Find two fractions, having prime denomi-

nators, whose sum shall be equal to $\frac{19}{35}$, or to $\frac{19}{7 \cdot 5}$.

Let the required fractions be $\frac{p}{7} + \frac{q}{5}$, then $\frac{5p + 7q}{35}$

$= \frac{19}{35}$; therefore $5p + 7q = 19$, whence $p = 1$, and

$q = 2$ (see **INDETERMINATE Analysis**); and consequently

the required partial fractions are $\frac{1}{7}$ and $\frac{2}{5}$.

Example 2.—Find three fractions, whose sum is equal to $\frac{401}{315}$.

The three factors of 315 are 5, 7, 9, which are of necessity the denominators of the required fractions. Suppose

then first, that $\frac{401}{315} = \frac{p}{35} + \frac{q}{9}$, whence we have $9p +$

$35q = 401$, which gives $p = 29$, and $q = 4$; therefore

$\frac{401}{315} = \frac{29}{35} + \frac{4}{9}$. Again, let $\frac{29}{35} = \frac{r}{7} + \frac{s}{5}$, or $5r +$

$7s = 29$; this gives $r = 3$ and $s = 2$, so that $\frac{29}{35} = \frac{3}{7} + \frac{2}{5}$,

and consequently $\frac{401}{315} = \frac{2}{5} + \frac{3}{7} + \frac{4}{9}$, as required. And

in the same manner the decomposition may be obtained in any other case, which falls within the limits above stated.

On the decomposition of rational algebraic fractions, and its application to the integral calculus.

Let $\frac{N}{D} = \frac{a + bx + cx^2 + dx^3 + \&c. \dots px^{m-1}}{a' + b'x + c'x^2 + d'x^3 + \dots p'x^{m-1} + q'x^m}$

be any rational fraction, whose decomposition into simple fractions is required, and whose numerator is at least one degree lower than its denominator, to which form it may always be reduced by division, if it should present itself under a different form.

The denominator of this fraction, from the known theory of equations, may be supposed to be made up of as many simple factors as is equal to the highest power of x contained in it, and which factors may be found by determining the roots of the equation formed by putting the whole denominator equal to zero. Let therefore $a' + b'x + c'x^2 + d'x^3 + \dots x^m = 0$, and suppose the roots of this equation to be $r, r', r'', r''', \&c.$, and we shall have $a' + b'x + c'x^2 + d'x^3 + \dots x^m = (x - r)(x - r')(x - r'')(x - r'''), \&c.$

And therefore our proposed fraction $\frac{N}{D}$ may now be put under the form

$\frac{N}{D} = \frac{a + bx + cx^2 + dx^3 + \dots px^{m-1}}{(x - r)(x - r')(x - r'')(x - r'''), \&c.}$

and these factors are now to form the denominators of the

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the simple fractions sought. Let $A, A', A'', A''', \&c.$ represent their numerators, so that

$$\frac{N}{D} = \frac{A}{x-r} + \frac{A'}{x-r'} + \frac{A''}{x-r''} + \&c. \frac{A^{(n-1)}}{x-r^{(n-1)}}$$

Reduce now these several simple fractions to a common denominator by the usual rule, and add their several numerators together; then comparing the co-efficients of the like powers of x in the numerator of this new fraction, with those in the numerator proposed, we shall obtain sufficient equations for determining the proper values of $A, A', A'', A''', \&c.$ and the decomposition will be effected as proposed. This will be better understood from a partial example.

Let us therefore assume the fraction $\frac{6x^2 - 4x - 6}{x^3 - 6x^2 + 11x - 6}$ which it is required to resolve into its simple fractions.

Here the roots of the denominator, by making it equal to zero, are 1, 2, and -3, whence the proposed equation may be put under the form

$$\frac{(x-1)(x-2)(x+3)}{x^3 - 6x^2 + 11x - 6} = \frac{A}{x-1} + \frac{A'}{x-2} + \frac{A''}{x+3}$$

which being reduced to a common denominator, and added together, give

$$\frac{A(x-2)(x+3) + A'(x-1)(x+3) + A''(x-1)(x-2)}{x^3 - 6x^2 + 11x - 6} = \frac{6x^2 - 4x - 6}{x^3 - 6x^2 + 11x - 6}$$

whence

$$\begin{aligned} A + A' + A'' &= 6 \\ A + 2A' - 3A'' &= -4 \\ 6A + 3A' - 2A'' &= 6 \end{aligned}$$

from which we readily draw $A = 1, A' = 2, A'' = 3$; so that the required fractions are

$$\frac{1}{x-1} + \frac{2}{x-2} + \frac{3}{x+3}$$

If therefore the fluent of $\frac{(6x^2 - 4x - 6)x}{x^3 - 6x^2 + 11x - 6}$ were required, we might immediately reduce the problem to finding the fluents of $\frac{x}{x-1} + \frac{2x}{x-2} + \frac{3x}{x+3}$, which are

known, being hyp. log. $(x-1) + 2$ hyp. log. $(x-2) + 3$ hyp. log. $(x+3) = \text{hyp. log. } [(x-1)(x-2)^2(x+3)^3]$

The same method may be employed for all rational fractions, whose denominators are resolvable into unequal simple factors, but as this cannot be generally effected when the highest power of the variable quantity exceeds the fourth degree, we are necessarily limited in our application of the rule, in consequence of the imperfection which still attends the general solution of equations. In the case, however, of equal factors in the denominator, a different process is required, which we will explain, after illustrating the above rule by two or three examples.

Required the fluent of $\frac{(1+x)x}{x-x^2}$ by resolving it into its simple fractions.

Here the factors of the denominator being x and $1-x$, we make

$$\frac{(1+x)x}{x-x^2} = \frac{Ax}{x} + \frac{A'(1-x)x}{1-x} = \frac{A + (A' - A)x}{x-x^2},$$

whence $A = 1$, and $A' - A = 1$, or $A' = 2$, therefore

$$\text{fluent } \frac{(1+x)x}{x-x^2} = \text{flu. } \frac{x}{x} + \text{flu. } \frac{2x}{1-x}$$

which are known.

Required the fluent of $\frac{(x-1)x}{1-4x+2x^2}$, or of $\frac{\frac{1}{2}(x-1)x}{\frac{1}{2}-2x+x^2}$.

Here, by making $x^2 - 2x + \frac{1}{2} = 0$, we have $x = 1 \pm \frac{1}{2}\sqrt{2}$; make, therefore,

$$\begin{aligned} \frac{(\frac{1}{2}x - \frac{1}{2})x}{\frac{1}{2} - 2x + x^2} &= \frac{Ax}{x-1-\frac{1}{2}\sqrt{2}} + \frac{A'x}{x-1+\frac{1}{2}\sqrt{2}} \\ &= \frac{A(x-1+\frac{1}{2}\sqrt{2})x + A'(x-1-\frac{1}{2}\sqrt{2})x}{\frac{1}{2} - 2x + x^2} \end{aligned}$$

Here we have $A + A' = -\frac{1}{2}(1 - \frac{1}{2}\sqrt{2})A + (1 + \frac{1}{2}\sqrt{2})A' = -\frac{1}{2}$, whence we have $A = -\frac{1}{4}$, and $A' = -\frac{1}{4}$, therefore fluent of $\frac{(x-1)x}{x-x^2} = \text{flu. } \frac{-\frac{1}{4}x}{x-1+\frac{1}{2}\sqrt{2}} + \frac{-\frac{1}{4}x}{x-1-\frac{1}{2}\sqrt{2}}$, which are known.

We have hitherto considered the factors of the denominators of the proposed fractions to be all unequal; when any number of them are equal, a little difference in the operation is then required; for it is obvious that if two of our

fractions were of the same form, for example $\frac{A}{x-r} + \frac{A'}{x-r}$,

these two would form, in fact, but one fraction $\frac{A+A'}{x-r}$,

which leads us to no useful result.

In case of equal factors, therefore, we must proceed as follows: let the proposed fraction be

$$\frac{a + bx + cx^2 + dx^3 + \dots + qx^{m-1}}{(x-p)^n(x-r)(x-r')(x-r'') \&c.}$$

Allume it equal to

$$\frac{B}{(x-p)^n} + \frac{B'}{(x-p)^{n-1}} + \frac{B''}{(x-p)^{n-2}} + \dots + \frac{B^{(n-1)}}{x-p} + \frac{A}{x-r} + \frac{A'}{x-r'} + \frac{A''}{x-r''} + \&c.$$

Where the upper line represents the fractions due to the n equal factors, and the lower those due to the $\frac{m}{n}$ unequal factors.

Let now these fractions be reduced to a common denominator, and the co-efficients equated as before, which will give us the required values of the several numerators sought.

Example.—It is required to convert $\frac{1-5x}{(1-x)(1+x)^2}$ into its equivalent simple fractions.

$$\begin{aligned} \text{Assume } \frac{1-5x}{(1-x)^2(1+x)} &= \frac{B}{(1+x)^2} + \frac{B'}{1+x} + \frac{A}{1-x} \\ &= \frac{B + (1+x)B'}{(1+x)^2} + \frac{A}{1-x} = \end{aligned}$$

$$\frac{B(1-x) + B'(1-x^2) + A(1+2x+x^2)}{(1+x)^2(1-x)} =$$

$$\frac{B + B' + A + (2A - B)x + (A - B')x^2}{(1+x)^2(1-x)}$$

3 N 2

whence

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whence
$$\begin{aligned} B + B' + A &= 1 \\ 2A - B &= -5 \\ A - B' &= 0 \end{aligned}$$
 therefore $B = 3, B' = -1, \text{ and } A = -1,$ consequently

$$\frac{1-5x}{(1+x)^2(1-x)} = \frac{3}{1+x} - \frac{1}{1+x} - \frac{1}{1-x}$$

We have in both the preceding cases extended the calculation to a greater length than it is necessary to observe in practical cases, in order that the reader might see distinctly the principles on which the decomposition depends. We shall now furnish him with an easier practical method, which we have extracted from Bonnycastle's Algebra, vol. i.

1. When the factors of the denominator of the given fraction are all unequal, or of the form

$$\frac{N}{D} = \frac{A}{x-r} + \frac{A'}{x-r'} + \frac{A''}{x-r''} + \frac{A'''}{x-r'''} + \&c.$$

take that which constitutes the denominator of the simple fraction which is to be found, and let S denote the product of all the remaining fractions; then if the root or value of x , in that factor, be substituted for x in the formula $\frac{N}{S}$, it will give the numerator of the fraction required.

2. If some of the factors are equal and others unequal, or of the form

$$\frac{N}{D} = \frac{A}{x-r} + \frac{A'}{x-r'} + \&c. \dots + \frac{B}{(x-p)^n} + \frac{B'}{(x-p)^{n-1}} + \&c.$$

let S denote the product of all the factors in the denominator, except one, as before; then find the simple fractions due to the unequal fractions as above, and for those of the equal factors proceed as follows:

$$1. B = \frac{N}{S}, \text{ taking } x \text{ in } N, \text{ and } S = p.$$

$$\text{Let } Q = \frac{N - BS}{x - p}, \text{ then}$$

$$2. B' = \frac{Q}{S}, \text{ taking } x \text{ in } Q, \text{ and } S = p.$$

$$\text{Let } Q' = \frac{Q - B'S}{x - p}, \text{ then}$$

$$3. B'' = \frac{Q'}{S}, \text{ taking } x \text{ in } Q', \text{ and } S = p.$$

$$\text{Let } Q'' = \frac{Q' - B''S}{x - p}, \text{ then}$$

$$4. B''' = \frac{Q''}{S}, \text{ taking } x \text{ in } Q'', \text{ and } S = p.$$

&c. &c.

Which operation being performed, the sum of the fractions thus obtained, together with the former, will give all the simple fractions into which the given fraction is resolvable.

Example 1.—It is required to convert the rational fraction $\frac{1+x^2}{x-x^3}$ into its equivalent simple fractions.

Here $\frac{1+x^2}{x-x^3} = \frac{A}{0+x} + \frac{A'}{1-x} + \frac{A''}{1+x}$; whence, by the preceding rule,

$$A = \frac{N}{S} = \frac{1+x^2}{1-x^2} = 1; \text{ being } 0 = x$$

$$A' = \frac{N}{S} = \frac{1+x^2}{x+x^2} = 1; \text{ being } 1 = x$$

$$A'' = \frac{N}{S} = \frac{1+x^2}{x-x^2} = -1; \text{ being } 1 = -x.$$

The required fractions are therefore

$$\frac{1}{x} + \frac{1}{1-x} - \frac{1}{1+x} = \frac{1+x^2}{x-x^3}.$$

Example 2.—It is required to convert the rational fraction $\frac{N}{D} = \frac{1}{x^3(1-x)^2(1+x)}$ into its equivalent simple fractions. Here

$$\frac{N}{D} = \frac{A}{1+x} + \frac{B}{x^2} + \frac{B'}{x} + \frac{B''}{x} + \frac{C}{(1-x)^2} + \frac{C'}{1-x};$$

whence for $1+x$, the first factor, we have

$$A = \frac{N}{S} = \frac{1}{x^3-2x^2+x} = \frac{1}{4}, x \text{ being } = -1$$

$$B = \frac{N}{S} = \frac{1}{1-x-x^2+x^3} = 1, x \text{ being } = 0.$$

$$\text{Let now } Q = \frac{N - BS}{x+p} = \frac{x+x^2-x^3}{x} = 1+x-x^2$$

$$B' = \frac{Q}{S} = \frac{1+x-x^2}{1-x-x^2+x^3} = 1, x \text{ being } = 0.$$

$$\text{Let } Q' = \frac{Q - B'S}{x-p} = \frac{2x-x^3}{x} = 2-x^2$$

$$B'' = \frac{Q'}{S} = \frac{2-x^2}{1-x-x^2+x^3} = 2, x \text{ being } = 0.$$

Again, for $(1-x)^2$

$$C = \frac{N}{S} = \frac{1}{x^3+x^2} = \frac{1}{2}, x \text{ being } = 1.$$

$$\text{Let now } R = \frac{N - CS}{x-p} = \frac{1-\frac{1}{2}x^3-\frac{1}{2}x^2}{x-1} = 1+x+x^2+\frac{1}{2}x^3$$

$$C' = \frac{R}{S} = \frac{1+x+x^2+\frac{1}{2}x^3}{x^3+x^2} = \frac{3}{2}, x \text{ being } = 1.$$

$$\text{Therefore } \frac{1}{x^3(1-x)^2(1+x)} = \frac{1}{x^3} + \frac{1}{x^2} + \frac{2}{x} + \frac{1}{2(1-x)^2} + \frac{1}{4(1-x)} - \frac{1}{3(0+x)}, \text{ as required.}$$

It is obvious, as we have before stated, that this decomposition of rational fractions must necessarily be affected as to its general application, by the imperfection of the theory of equations, which will not admit of a practical resolution of the denominator into its simple factors in all cases. It will also further appear, that, in case of any of the roots being imaginary, the same will necessarily enter into the numerators of the simple fractions. But this difficulty may be avoided: for since the imaginary roots of equations always enter in pairs, and the product of such pairs of roots being always real, being of the form

$$x^2 + 2\alpha x + \alpha^2 + \beta^2,$$

we may, instead of resolving the fractions into the simple

fractions $\frac{A}{x-r}, \frac{A'}{x-r'}, \frac{A''}{x-r''}, \&c.$ resolve it into as many of these fractions as it has rational simple factors, and into as many fractions of the form $\frac{Bx+C}{x^2+\alpha x+\alpha^2+\beta^2}$, as it has pairs of imaginary factors, and then proceed as before.

We

We cannot extend our remarks to a greater length in this article; we must, therefore, refer the reader who wishes to see these principles more completely developed, to Euler's *Analysis Infinitorum*, vol. i. ch. 2 and 11; to La Croix's *Algebra*, and his *Calcul Differentiel et Calcul Integral*. See also Bonnycastle's *Algebra*, and Simpson's *Fluxions*.

RATIONAL or *true horizon*, is that whose plane is conceived to pass through the centre of the earth; and which therefore divides the globe into two equal portions, or hemispheres. See **HORIZON**.

It is called the *rational horizon*, because only conceived by the understanding; in opposition to the *sensible* or apparent horizon, which is visible to the eye.

RATIONAL integer, or *whole number*, is that of which unity is an aliquot part. See **NUMBER**, and **ALiquot part**.

RATIONAL mist number is that consisting of an integer, and a fraction; or of unity, and a broken number.

Commensurable quantities are defined by being one to another as one rational number to another.

For unity is an aliquot part of a rational number; and a fraction has some aliquot part common with unity; in things, therefore, that are as a rational to a rational number, either the one is an aliquot part of the other, or there is some common aliquot part of both; therefore they are commensurable.

Hence, if a rational number be divided by a rational, the quotient is always a rational.

RATIONAL Physicians, in ancient medical history, the physicians of the *dogmatic sect*, who stood in opposition to the *empiric sect*; the former appealing to certain theoretical principles in the application of remedies, while the latter rested entirely upon experience, and disclaimed all knowledge of first principles. The tenets of both these sects have been handed down to us by a classic author, Celsus, and have been given at length under a former article. See **EMPIRIC**.

RATIONAL Quantity, or *number*, a quantity or number commensurable to unity.

Supposing any quantity to be 1, there are infinite other quantities, some of which are commensurable to it, either simply, or in power: these Euclid calls *rational quantities*. The rest, that are incommensurable to 1, he calls *irrational quantities*, or *surds*.

RATIONAL Ratio. See **RATIO**.

RATIONAL Soul. See **SOUL**.

RATIONALE, a solution or account of the principles of some opinion, action, hypothesis, phenomenon, or the like. Hence,

RATIONALE is also the title of several books. The most considerable is the "*Rationale of Divine Offices*," by Guil. Durandus, a celebrated school-divine, bishop of Mende, finished in 1286, as he himself tells us. See **PRINTING**.

RATIONALE also denotes an ancient sacerdotal vestment, worn by the high-priest under the old law; and called by the Hebrews, *חֹשֶׁן*, *hoshchen*; by the Greeks, *λογιον*; by the Latins, *rationale* and *pectoral*; and by the English translators, *breast-plate*.

The rationale was a piece of embroidered stuff worn on the breast, about a span square. Du-Cange describes it as a double square of four colours, interwoven with gold, and set with twelve precious stones in four rows, on which were engraven the names of the twelve tribes, and fastened to the shoulder by two chains and two hooks of gold. The form of the rationale was prescribed by God himself, Exod. xxviii. 15—29.

A rationale appears also to have been anciently worn by the bishops under the new law. But authors are in doubt

about its form; some will have it resemble that of the Jews; others take it to be only the pallium.

RATIONALIS, an officer mentioned in several ancient inscriptions.

Lampridius, in the life of Alex. Severus, uses *rationalis* as synonymous with procurator.

The *rationales* were intendants or surveyors under the emperors; and though Lampridius pretends they were first established by Severus, it is evident there were some under Augustus.

RATIONARIUM, among the Romans, a book which contained the accounts of the empire. It was otherwise called *breviarium*. See **BREVIARY**.

RATIONIS ENS. See **ENS**.

RATIONIS Distinctio. See **DISTINCTIO**.

RATIONIS Os, in *Anatomy*, the bone of the forehead, otherwise called *os frontis*.

RATISBON, or **REGENSPERG**, in *Geography*, an imperial city of Germany, in the circle of Bavaria, and capital of a bishopric of the same name, situated at the conflux of the Regen and of the Danube. The town is large, populous, and fortified; and was anciently the capital of Bavaria, and the residence of its dukes. The emperor Frederic I. annexed it to the empire. This town is a staple, but neither its manufactures nor trade are very considerable; corn, wood, and provisions, are sent by the Danube to Vienna. The number of inhabitants is about 24,000; 62 miles N.E. of Augsburg. N. lat. 48° 55'. E. long. 12° 50'.

The bishopric of Ratibon comprehends about 1383 parishes; and was founded, as it has been supposed, by St. Boniface, in the year 736. The seat of the bishop is at Ratibon, where, however, he has no jurisdiction.

RATISKA, a town of Immeritia; 35 miles N.E. of Cotatis.

RATKAI, **GEORGE**, in *Biography*, born in 1613, of a noble family, in Hungary, entered into holy orders, and was made canon of the church of Zagrab. He obtained the esteem of the viceroy of Croatia, John Draskovitz, who engaged him to compose the history of that province, and gave him free access to its archives. He accordingly published, in 1652, a very learned work, entitled "*Memoria Regum et Banorum regnorum Dalmatiae, Croatiae, Slavoniae, inchoata ab origine sua usque ad annum*." Gen. Biog.

RATLINES, or, as the seamen call them, *Rutlins*, or *Rattlings*, are certain small lines which traverse the shrouds of a ship horizontally, at regular distances above the dead-eyes upwards, and forming a variety of ladders, whereby to climb to any of the mast-heads, or descend from them. Hence the term seems to be derived from *rath*, an obsolete word, signifying *a hill*. In order to prevent the rattling from slipping down by the weight of the sailors, they are firmly attached by a knot, called a *clove-hitch*, to all the shrouds, except the foremost or aftmost; where one of the ends, being fitted with an eye-splice, is previously fastened with twice-thread or pack-thread. Falconer.

RATNO, in *Geography*, a town of Lithuania, in the palatinate of Brzesc; 50 miles S.E. of Brzesc.

RATOATH, a poor village of the county of Meath, Ireland, which, before the union, had its representatives in parliament. It gave name to a barony, and is 12½ miles N.W. by N. from Dublin.

RATOLY, a town of Hindoostan, in the circle of Golind; 25 miles S.E. of Raat.

RATONES, a small island in the river La Plata, near Monte Video.

RATSCHA,

RATSCHA, or RETZKA, a fortress of Slavonia, on the N. side of the Save, opposite to the mouth of the Drin; 35 miles S.W. of Peterwardein.

RATSCHITZ, a town of Moravia, in the circle of Brunn; 10 miles N.E. of Brunn.

RATSUR, a town of Hindooistan, in the circle of Aurungabad; 65 miles E. of Aurungabad.

RATTAK, a town of Bengal; 14 miles S.S.E. of Curruckpour.

RATTAN. See RUATAN.

RATTAN Canes. See CANES.

RATTELSDORF, in *Geography*, a town of Bavaria, in the bishopric of Bamberg; 9 miles N. of Bamberg.

RATTEN. See RATEEN.

RATTEN, in *Rural Economy*, a provincial word, used to signify a rat.

RATTENBERG, in *Geography*, a town of the county of Tyrol, with a citadel on the Inn; 16 miles E.N.E. of Innsbruck.

RATTKOW, a town of the duchy of Holstein; 6 miles N.N.E. of Lubeck.

RATTLE, among the *Ancients*, a musical instrument called by the Romans *crepitaculum*.

Mr. Malcolm takes the tintinnabulum, crotalum, and sistrum, to have been only so many different kinds of rattles.

The invention of the rattle is ascribed to the famous mathematician Archytas; whence Aristotle calls it *Ἀρχύτας πλάζων*, Archytas's rattle. Diogenianus adds the occasion of the invention; viz. that Archytas, having children, he contrived this instrument to prevent their tumbling over things about the house. So that how much soever some instruments have changed their uses, the rattle, we are sure, has preserved its original application.

RATTLE, or *Rattel*, in *Commerce*, a weight in Arabia; a rattle of coffee contains, at Betelfagui, $14\frac{1}{2}$ vakias, and a farcel, or frazil, of 10 maunds, or 20 rattles, contains 290 vakias; a farcel weighs 20lb. 6oz. 4 dr. avoirdupois, and a bahar of 40 farcels = $815\frac{1}{4}$ lb. avoirdupois; 10 farcels in Betelfagui are equal to 7 in Mocha; 16 vakias of dates, candles, and iron, are reckoned to a rattle; but of all other sorts of goods 15 vakias make a rattle. The rattle is used in the bazar, or market, only. At Jiddah, another sea-port of Arabia, in the Red sea, the bahar contains 10 frazils, 100 maunds, or 500 rattles, and the rattle 15 vakias. The bahar weighs $222\frac{1}{2}$ lb. English troy, or 183lb. avoirdupois; and the maund 29 oz. $4\frac{1}{2}$ dr. avoirdupois. Kelly's Un. Cambist.

RATTLE-Grass. See RHINANTHUS.

RATTLE-Net. See WOLF Net.

RATTLE, Red. See PEDICULARIS.

RATTLE, Yellow. See RHINANTHUS.

RATTLE-SNAKE. See SNAKE.

RATTLE-SNAKE Root, *Senegaw*. See MILK-wort.

RATTLE-SNAKE Root, Dr. Witt's, a species of *Prenanthes*; which see.

RATTLE-SNAKE Weed, a species of *Eryngium*; which see.

RATTLE-SNAKE Islands, in *Geography*, a cluster of small islands at the western extremity of lake Erie.

RATTLE-SNAKE Mountains, mountains of New Hampshire; 38 miles N. of Concord.

RATTLING in horses, a term applied to a disagreeable noise produced in them by the entrance of the air between the internal parts of the sheath and the prepuce or covering, principally taking place in trotting or going fast.

RATTONNEAU, in *Geography*, a small island at the

entrance of the harbour of Marseilles, which has a fortress erected in the 17th century by the duke of Guise.

RATTRAY HEAD, a cape of Scotland, on the N.E. coast of the county of Aberdeen; 7 miles N. of Peterhead. N. lat. $57^{\circ} 12'$. W. long. $1^{\circ} 44'$.

RATULAH, a town of Hindooistan, in Oude; 15 miles N.E. of Fyzabad.

RATWAH, a town of Hindooistan, in the circle of Gohud; 27 miles E. of Gwalior.

RATZE, in *Commerce*, the name of a small coin, struck at Friburgh, &c. nearly of the same value with the *blanc*, which, in France, is worth two sols and a denier.

RATZEBUR, in *Geography*, a town of Hinder Pomerania; 14 miles S. of New Stettin. N. lat. $53^{\circ} 30'$. E. long. $16^{\circ} 14'$.

RATZEBURG, a town of Germany, which gives name to a principality, situated on an island in a large lake; the lake is 30 miles long, and 9 broad, and boats pass by it to Lubeck with goods and passengers. It was burnt by the Danes in 1693, and since that disaster the streets have been regularly laid out, and the houses are built after the Dutch manner. In the market-place is the regency-office, and here is held the chief court of justice and the consistory; the garrison is quartered in barracks; 20 miles S. of Lubeck. N. lat. $53^{\circ} 43'$. E. long. $10^{\circ} 46'$. The principality of the same name is situated between Mecklenburg and Saxe-Lauenburg, and extends about 10 miles each way. The soil is fertile, and produces a considerable quantity of wheat, besides feeding a number of cattle. It was converted from a bishopric into a principality by the peace of Westphalia. It belongs to Mecklenburg-Strelitz.

RATZENSTEIN, a town of the duchy of Stiria; 5 miles S. of Windisch Gratz.

RATZKNITSCHA, a town of Hungary; 10 miles N.N.W. of Csakathurn.

RAVA. See RAWA.

RAVALEMENT, Fr. equivalent, among organ-builders and harpsichord-makers, to *compass* in English. The complete set of keys, or whole system of musical sounds, (said Rousseau in 1768,) instead of confining itself to four octaves, like common keyed-instruments formerly, extends now to five octaves, adding a fifth below double C, and a fourth above C in alt., including five octaves between the lowest F and the highest. (This was the common compass of our harpsichords made by Tabel, Kirckman, and Shudi, long before 1768.) The word *ravalement* is confined to keyed-instruments; there are no others of so extensive a compass as five octaves. But in the year 1777, when Dr. Burney first composed and published duets "à quatre mains," or for two performers on one instrument, the ladies, at that time wearing hoops, which kept them at too great a distance from each other, had a harpsichord made by Merlin, expressly for duets, with six octaves; extending from the octave below double C in the base, to the octave above C in alt. in the treble. And as duets à quatre mains have been composed by all the great masters in Europe since that time, instruments with additional keys are now become general. At first it was only in the treble that the compass was extended, except in the instrument above-mentioned by Merlin; but at present notes are added in the base to complete the six octaves: and, indeed, the additional notes in the base are better worth having for particular effects, than those in the treble; which often, from the shortness of the strings and feeble vibration, more resemble the tone of wood than wire; whereas the tone of those in the base of large piano fortes, by the best makers, is so rich and full, that

that each found below double F resembles that of an organ-pipe in slow notes, more than the transient tone of a string.

Rousseau very justly observes, that almost all instruments are limited in their compass *below*, except harps and instruments with keys. The violoncello can go no lower than double C, its 4th string, nor the violin below G. The flute and hautbois descend only to D and C. But the notes in alt. have been extended in the acute to sounds that are seldom in tune, and never pleasing. Like rapid notes of difficult execution, they *surprize*, and the performer's dexterity is applauded; but neither the harmony nor the melody of very high or rapid sounds can excite rapture like those of moderate quickness, when produced with feeling and expression, in the middle of the scale.

RAVALSHE, in *Geography*, a town of Sweden, in West Gothland; 24 miles N.W. of Uddevalla.

RAVANA, in *Hindoo Mythology*. See RAVENA.

RAVANAK, in *Geography*, a town of European Turkey, in Macedonia; 16 miles E.S.E. of Saloniki.

RAUAND, a town of Persia, in the province of Kerman; 105 miles E. of Sirgian.

RAVA-POU, in *Botany*, Rheede Hort. Malab. v. 4. 99. t. 48, a plant erroneously cited by Linnæus for his very different *Nyctanthes hirsuta*. See GUETTARDA *Speciosa*.

RAUCA AVIS, in *Ornithology*, the name of a bird described by Nieremberg, as common about the lakes and rivers of America, and of the kingfisher kind, but nearly as large as a duck, and black on the crown, and white on the breast and belly. Its neck is naturally very long in proportion to its body, yet it can occasionally contract and shorten it in a very wonderful manner. It is a native of Mexico, and is esteemed very good for the table. Mr. Ray has placed this among the birds, the accounts of which he is distrustful of.

RAUCH, in *Geography*, a town of Germany, in the lordship of Schwarzenberg; 10 miles S.W. of Scheinfeld.

RAUCHENEGG, a town of Austria; 2 miles W. of Baden.

RAUCHT, a town of Russia, in the government of Viborg, near lake Ladoga; 44 miles S.E. of Viborg.

RAUDANAGUR, a town of Bengal; 30 miles E. of Ramgur.

RAUDEN, a town of Prussia, in the palatinate of Culm; 10 miles N.E. of Culm.—Also, a town of Silesia, in the principality of Ratibor; 12 miles N.E. of Ratibor.

RAUDNIZ, a town of Bohemia, in the circle of Schlan; 12 miles N.N.E. of Schlan.—Also, a town of Bohemia, in the circle of Chrudim; 16 miles N.N.W. of Chrudim.

RAUDRI, a name of the Hindoo goddess *Parvati*, consort of *Siva*, the destroying power. In this character she may be considered as his *Sakti*, or energy in his form of *Rudra*, or Fate. *Rudri*, and *Rudrani*, are other modes of writing this name of the goddess in her avenging character, in which she does not apparently differ much from her attributes, as *Sakti* of *Mahakala*; under which name, and the others occurring in this article, distinguished by italics, farther and sufficient information may be sought. See also TRISAKTI-DEVI, and TAMASI.

RAUDTEN, in *Geography*, a town of Silesia, in the principality of Wohlau; 18 miles N.W. of Wohlau. N. lat. 51° 30'. E. long. 16° 15'.

RAVEL BREAD, a sort of bread, called also *blackwhylof*, as being of a middle fineness betwixt white and brown.

RAVELIN, in *Fortification*, was anciently a flat bastion, placed in the middle of a curtain.

RAVELIN is now a detached work, composed only of two faces, which make a salient angle, without and sometimes with flanks; and raised before the curtain on the counterscarp of the place; serving to cover it and the joining flanks from the direct fire of an enemy.

A ravelin is a triangular work, resembling the point of a bastion, with the flanks cut off. (See *Plate V. Fortification*, fig. 4. lit. iii. &c.) Its use before a curtain is, to cover the opposite flanks of the two next bastions. It is used also to cover a bridge or a gate, and is always placed without the moat.

What the engineers call a ravelin, the soldiers generally call a demi-lune, or half-moon. See DEMI-LUNE.

There are also *double ravelins*, which serve to defend each other. They are said to be double when they are joined by a curtain.

Ravelins, or half-moons, are constructed by setting off 50 toises from the re-entering angle O of the counterscarp (*Plate VII. Fortification*, fig. 4.) on the capital OI. of the ravelin, or on the perpendicular produced, and from the point L drawing lines to the shoulders A, B; whose parts LM, LN, terminated by the counterscarp, will be the faces MO, ON, the semi-gorges of the ravelin required. Others will have the faces of the ravelin to terminate on those of the bastions within three toises of the shoulders, in which case the ravelins cover the flanks better than the others. The ditch before the ravelin is 12 toises, and its counterscarp parallel to the faces of the ravelins, and made in a circular arc before the salient angle. When the ravelins are made with flanks, the faces should terminate those of the bastions, at least 5 toises from the shoulders. These flanks are made by setting off 10 toises from the extremities of the faces, and from the points thus determined, the flanks are drawn parallel to the capital of the ravelin. When redoubts, or keeps, are formed in the ravelin, this is done by setting off 16 toises from the extremities of the faces, on the semi-gorges from N to *b*, and from M to *a*; and from the points *b*, *a*, the faces are drawn parallel to those of the ravelin: the ditch before this redoubt is 6 toises, and its counterscarp parallel to the faces. This work should be covered in the faces by a wall, a foot or two thick, furnished with loopholes for the musketry to fire through; and it will serve to secure a retreat for the troops who defend the ravelin; they may thus prevent the enemy from making a lodgment in the outward part of the ravelin, or at least greatly obstruct their attempts for this purpose. Nor can they be drove from this place, until the enemy has erected a battery, and brought cannon on the ravelin to batter the redoubt. When the *counterguard* (which see) is placed before the ravelin, 40 toises are set off on the capital of the ravelin from its salient angle to the salient angle of the counterguard, and 10 on the counterscarp of the ditch. For the construction of crown-works before the ravelin, see HORN-work. Within the ravelin are constructed a rampart of about 16 or 20 yards, and a parapet of about 6 yards: ramps are also annexed in the slope of a rampart, and a barbet, when it is proper, is constructed in a salient angle. In wet ditches, where the troops pass from the town to the ravelin in boats, it is proper to make, in the gorge of the ravelin, a kind of harbour, where the boats may be covered from the fire of the enemy. In dry fosses, there should be ramps or stairs in the gorge of the ravelin, to preserve a free communication, if the bridges should be broken down by the enemy's shot. The celebrated general Coehorn, in the ravelins which he built at Bergen-op-zoom, contrived a very good defence for the covered way before the faces of the bastions, by making retired flanks in the breasts of the ravelin, where

one or two cannon might be placed as secure from the enemy's fire as those behind the orillon of a bastion. See *Military CONSTRUCTION*.

RAVELLO, in *Geography*, a sea-port town of Naples, in Principato Citra, the see of a bishop, united to Scala; 11 miles W.S.W. of Salerno. N. lat. 40° 39'. E. long. 12° 10'.

RAVELWATER, a river of the county of Antrim, Ireland, rising in the mountains in the northern part, and flowing through Ravel glen to the river Main.

RAVEN, CORVUS, in *Astronomy*. See CORVUS.

RAVEN, *Corvus corax* of Linnæus, in *Ornithology*, a large bird of the crow kind, well known throughout the world, as being found in all climates, and all regions. The colour of the whole bird is black, finely glossed with a rich blue, the belly excepted, which is dusky. The ravens build in high trees, or upon the ruins of lofty buildings in the neighbourhood of great towns, being held in the same veneration as the vultures are in Egypt, and for the same reason; for devouring the carcases and filth that would otherwise prove a nuisance. They lay five or six eggs, of a pale greenish colour, marked with small brownish spots. There are many fabulous stories of the longevity of the raven; but birds are in general long lived, and the crow kind not less so than the rest. The raven is a very docile bird, and may be taught to speak, as well as to fetch and carry. In clear weather, ravens are remarked to fly in pairs at a great height, making a deep loud noise, different from the common croaking; and their scent is remarkably good. See *CORVUS Corax*.

The quills of a raven are used in tuning the lower notes of a harpsichord, when the wires are set at a considerable distance from the sticks.

It is rare to find this creature white, yet it happens sometimes. Boyle mentions one. There was also one shewn to the Royal Society some years ago. Boyle's Works abr. vol. ii. p. 46.

RAVEN, *Night*, an English name for a heron, which flies in the night, and makes a very odd and hoarse noise. It has been applied by some to the bittern, or *ardea stellaris*, but improperly, belonging of right to the smaller grey heron, called *nycticorax*. See *HERON*.

RAVEN, *Sea*, or *Corvorant*. See *CORVUS Aquaticus*.

RAVENA, in *Hindoo Mythology*, is the name of a celebrated king of Lanka, or Ceylon. Such was his prowess, and the oppression which he exercised over his subjects, that it became necessary for Vishnu, the preserving power of the deity, to descend on earth for his destruction, and the relief of the suffering world. He accordingly became incarnate in the person of Rama; and the wars that ensued between the forces of the tyrant and the divine general, for the recovery of Sita, his ravished spouse, are the subject of the fine epic poem, the *Ramayana*; under which article of this work, and under *Rama*, and others thence referred to, the poem, and the historical traditions connected with these points, are sufficiently described and discussed.

Although obscured by mythological fables, these persons and wars are admitted to have had historical existence; and some important points of chronology hinge upon them. We have, therefore, in this and other articles, noticed at some length the legends connected with these subjects.

In the Hindoo theology, the origin of Ravena is thus related. Two ethereal warders of Vishnu's palace carried the pride of office so far as to insult the seven Maharshis, (see *MAHARSHI*, or *RISHI*,) who had come to offer their adorations. The offended saints pronounced an imprecation on the insolent warders, condemning them to be *adho-*

yoni, or *born below*, thrice in mortal forms, before they could be re-admitted into the divine presence. The imprecation of a Rishi, even if provoked by a god, is scarcely to be averted; and the offenders, in consequence, appeared in their first birth as Hiranyaksha, or golden-eyed, and Hiran-yakshipu, or clad in gold; secondly, as Ravena and Kumbhakarna; and lastly, as Kanva and Sifupala.

The history, if such it may be called, of Ravena, Rama, &c. is perpetually alluded to in Hindoo writings; the *Ramayana*, containing an infinity of such legends, being one of the most popular works of the East. Ravena, or Ravana, has become a generic name for a tyrant. He is also called Dasagriva, or the ten-necked; he being usually represented with that number of heads, and twenty hands, symbolical of sapience and prowess. A couplet in the *Ramayana* may be thus translated. "Where Ravana is, the sun loses his force, the winds cease to blow, the fire ceases to burn: the rattling ocean, seeing him, stills its waves." Such are the hyperbolical relations of his potency, obtained by the usual process of self-inflicted autterities. So ardent was he in this irresistible species of merit, that he offered to Siva nine of his ten heads successively; and thus extorting the favour of the condescending deity, pleased with such an important sacrifice, he obtained a promise, with some equivocal stipulations, of whatever he should desire. This sort of austerities is called *Tapas*, under which word some account is offered of various modes of practising it. The gods and demi-gods, alarmed at Siva's promise, besought him to recall it. But such conduct is deemed unbecoming in deities, who, however, do not scruple to evade the performance of their promises by deceit or prevarication: and, on this occasion, Nareda was deputed to sound Ravena as to what he would demand, which, as usual, was universal dominion, &c. Nareda artfully persuaded Ravena that Mahadeva (or Siva) was drunk, and had promised him what he could not perform: whereupon the vindictive giant tears up Kailasa, the paradise of Siva, which, being contrary to the stipulations, releases Siva from his promise, and he consents to the destruction of Ravena, which is brought about by the avatara, or descent, of Vishnu in the person of Rama. From this story we are told to learn that all worldly affairs are the predestined ordainments of providence; whose will, that any event should take place on earth, includes presciently all the routine and detail of its accomplishment; although we only see the links of a chain of causes leading naturally to its effect.

We will here add an extract from the Hindu Pantheon, whence a considerable part of this article is taken, shewing how unceasingly the mythological machinery of that poetical people is introduced into their popular works. The names distinguished by capitals imply that articles are given under those words, in this work; and a reference may be made to them for any desired information.

"Respecting Ravena," says the author of the publication adverted to, "I will notice but one more tale, as related to me by a Brahman; who, unable fully to make me feel the poetical beauties, or comprehend the morality of the *Ramayana*, blushed while he developed its follies; which, in conformity with popular taste, or if taken separately, are apparently very numerous; although it must be confessed, they are so contrived as to be intimately connected with the main action of the poem. The following idle tale is of this description: but I shall not here explain the causes that led to the predicament, or the consequences that ensued.

"Ravena, by his power and infernal arts, had subjugated all

all the gods and demi-gods, and forced them to perform menial offices about his person and household. INDRA made garlands of flowers to adorn him withal. Agni, or PAVAKA, was his cook. SURYA, regent of the sun, supplied light by day; and SOMA, regent of the moon, by night. VARUNA, the Hindoo Neptune, purveyed water for the palace. KUVERA, their Plutus, furnished cash. The whole NAVA-GRAHA (the nine planetary spheres, including RAHU and KETU) sometimes arranged themselves into a ladder, by which, they serving as steps, the tyrant ascended his throne. BRAMA (for the great gods were there also, and I give this anecdote as I find it in my memoranda, without any improved arrangement) was a herald, proclaiming the giant's titles, the day of the week, month, &c. daily in the palace; a sort of speaking almanac. MAHADEVA, in his character or incarnation of KANDEH-RAO, performed the office of barber, and trimmed the giant's beards. VISHNU had the honourable occupation of instructing and drilling the dancing and singing girls, and selecting the fairest for the royal bed. Ganefa, or POLLEAR, had the care of the cows, goats, and herds. VAYU swept the house. YAMA washed the linen. And in this manner were all the gods employed in the menial offices of Ravena, who rebuked and flogged them in default of industry and attention. Nor were the female divinities exempted: for PARVATI, in her form of SATWI, was head Aya, or nurse, to Ravena's children. LAKSHMI and SARASWATI were also among them, but it does not appear in what capacity. Earthly kings and queens were also forced into this degrading servitude, to the number of ninety-six royal families; as is said to be detailed in the RAMAYANA. But I have some doubt if such a relation be actually in this shape, in that poem: this we shall see, when its other books are translated and published. In my abstract of it, however, such a godly predicament seems essential to the main action; RAMA being thereby impelled by every consideration of piety and duty to immediate and energetic measures, for the relief and liberation of the degraded divinities."

Ravena, as we have noticed, is surnamed Dasagriva, or the ten-headed. He is also called Visravana, or son of Visrava, the father likewise of Kuvera. The brothers are sometimes named *Pulastya*, or *Paulastya*. (See these articles.) Another of his names is equivalent to lord of Rakshasas, a race of malignant beings, common agents in the hands of superhuman tyrants for the annoyance of the virtuous portion of mankind, or thwarting the benificent views of the gods. Many specific varieties of these demons are enumerated in the first book of the Ramayana, as aiding Ravena in defence of himself and his kingdom of Lanka. In pictures illustrative of the Ramayana, which are very common throughout India, they are depicted especially ill-favoured, painted green, red, blue, &c. and engaged in fierce contests with Rama's simian soldiery. Several legions of these Rakshas, each of 14,000, were destroyed by Rama. See RAKSHA.

RAVENALA, in *Botany*, Adans. Fam. des Plantes, v. 2. 67. Juss. 62. See URANIA.

RAUENBACH, in *Geography*, a town of Germany, in the principality of Anspach; four miles S.S.W. of Anspach.

RAVENGLASS, a market-town and sea-port in the parish of Muncaster, Allerdale ward, above Darwent, county of Cumberland, England, is situated on the Solway Frith, near the confluence of the rivers Esk, Mite, and Irt. Though possessing many advantages for trade, it is but a poor place, and chiefly supported by its oyster fishery, for which it is much celebrated. This town stands at the dis-

tance of 57 miles S.S.W. from Carlisle, and 287 N.W. by N. from London. The manor originally constituted part of the barony of Egremont, but was granted by Richard Lucy to the Penningtons, from whom the present owner, lord Muncaster, is lineally descended. The market day is Saturday, weekly; and there are two annual fairs, one of which is held on the eve, day, and morrow, of St. James, and is remarkable for the ceremonies attending its proclamation and continuance. On the first day, the earl of Egremont, or his proxy, attends, accompanied by the serjeant of the borough of Egremont, with the insignia, called the Bow of Egremont; by the foresters, with their bows and arrows; and by all the tenants of the forest of Copeland, who hold their estates by the special service of attending the earl, or his representative, during the fair. On the third day, at noon, the earls, officers, and tenants of the forest, depart, after proclamation; and lord Muncaster, and his tenants, take formal re-possession of the place, and the day is concluded by horse-racing, and various rustic diversions.

Near Ravenglass, on the northern bank of the river Esk, stands Muncaster-house, the seat of lord Muncaster; and east from it, on the opposite side of the river, are seen ruins of considerable magnitude, respecting which no historical documents are known to exist. They are now called the *city of Barnscar*; and its foundation is ascribed, by tradition, to the Danes, who are said "to have gathered for its inhabitants the men of Drig, and the women of Beckermont," whence the popular saying, "let us go together like lads of Drig and lasses of Beckermont." These ruins extend about three hundred yards in length from east to west, and 100 in breadth, from north to south; and are enclosed, except at the east end, by a wall, nearly three feet in height. "There appears," says Hutchinson, "to have been a long street, with several cross ones; the remains of the housesteads within the walls are not very numerous; but on the outside they are innumerable, especially at the south side and west end. The circumference of the city, and suburbs, is nearly three computed miles; the figure is an oblong square. There is an ancient road through the city, leading from Ulpha to Ravenglass. About the year 1730, a considerable quantity of silver coin was discovered in the ruins of one of the houses, concealed in a cavity formed in a beam." A History of the County of Cumberland, &c. by William Hutchinson, F.S.A., two vols. 4to. Beauties of England and Wales, vol. iii., 1802, by John Britton and Edward Wedlake Brayley.

RAVENNA, a very ancient city of Italy, in the department of the Amone, seated on the river Mentone, near the Adriatic. This city, as Strabo informs us, was built by the Thessalians, on several islands, long before the war of Troy, and they were driven out by the Tuscans. In the time of this Greek writer, it was situated in the midst of a marsh, and attached to the continent, and in process of time the Po accumulated mud and sand, so that the land was raised and the sea removed to a greater distance. The same writer informs us, that it was made a Roman colony by Augustus; and Dion says, that a fleet of 250 vessels was stationed in this port by that prince, from which circumstance it was called "portus classis," or the port of the fleet. He stationed, says Suetonius, one fleet at Misenum, and another at Ravenna, for guarding the upper and lower sea. Tiberius repaired its walls, and erected some new gates, which still bear an inscription to this purpose. Trajan also contributed towards embellishing this city. Honorius made it the place of his residence, both before and after Alaric had captured and burned Rome. When Odoacer made a conquest of Italy, he resided at Ravenna, and sustained here a siege

of three years, at the termination of which he was taken and slain by Theodoric. Theodoric fixed the seat of his empire in this place, and adorned it with magnificent churches and palaces, and re-constructed the aqueduct of Trajan. His daughter Amalasoutha, and his grandson Athalaric, contributed towards the improvement of this city. When the Goths were driven from Italy by Narfes, general of the emperor Justinian, he was made governor of Ravenna; and having continued in this station for 16 years, he was recalled by Justin II., successor to Justinian; and in the year 567 he was succeeded by Longinus, who took up his residence at Ravenna, under the title of exarch. (See EXARCH.) The famous battle of Ravenna was fought near this town between Gaston de Foix, duke of Nemmes, and nephew of Louis XII. and the army of pope Julius II., Ferdinand, king of Spain, and the Venetians, in which the former young general, being only 24 years of age, having killed between 16 and 18,000 of the enemy, proved victorious, though he himself was killed by too ardently following the pursuit. This happened on Easter-day 1512. The French, enraged by the loss of their brave general, took Ravenna by storm, and pillaged the city with such severity that it has never recovered. On the road to Forlì, by the banks of the little river Ronco, three miles from the city, a cross shews the spot where Gaston de Foix was killed. Fresh water has always been so scarce at Ravenna, that it has occasioned a pleasant epigram by Martial. This city was of late the capital of Romagna, with the title of an archbishopric. It has produced several persons of eminence, as Faustinus, often mentioned by Martial; the sophist Apollonius, who lived under the reign of Alexander Severus; Cassiodorus, chancellor to Theodoric, king of the Goths in Italy; pope John XVII.; Peter Damien, cardinal of Offa, and several others. Ravenna was also the seat of many councils at successive periods. The three last councils, in 1311, 1314, and 1317, were summoned for the purpose of reforming the corrupted manners of the ecclesiastics, which were, in those days, very debauched. It is now a mean and inconsiderable town; the houses are old and in a ruined state, and the number of inhabitants scarcely amounts to 14 or 15,000. In the time of the Romans, it was seated on a kind of bay formed by the Adriatic, and its harbour was celebrated; but it is now three miles from the sea. The mud thrown up by the tide having formed a tract of land, which is cultivated, and on which the city itself has been enlarged towards the sea. The air is insalubrious; but has been somewhat amended by conveying along the sides of the city the rivers Mentone and Ronco, which carry off the foetid water from the marshy grounds. It contains several churches, and 24 convents; 42 miles E. of Bologna. N. lat. 44° 27'. E. long. 11° 5'.

RAVENPOINT, a headland of the county of Wexford, Ireland, at the N. side of the entrance into Wexford haven. N. lat. 52° 23'. W. long. 6° 18'.

RAVENSARA, in *Botany*, a barbarous appellation, altered by Sonnerat from the Madagascar name of the plant, *Raven-tsara*, or *Voaravendtsara*, meaning, it seems, a *good leaf*, and applying to the aromatic qualities, and economical uses, of the leaves. Hence Jussieu was induced to contrive the apt generic name *Agathophyllum*, from *αγαθος*, *good or profitable*, and *φυλλον*, *a leaf*; under which this genus ought to have been described in its proper place, in our first volume. But one of our predecessors has, by mistake, referred the reader to *Ravensara*, as a genuine Linnæan name, attributing *AGATHOPHYLLUM* to professor Martyn; see that article. To correct this error, and supply the consequent deficiency, we subjoin an account of the tree in question, under its proper and received denomination.

AGATHOPHYLLUM. Juss. 431. Schreb. 806. Willd. Sp. Pl. v. 2. 842. Mart. Mill. Dict. v. 1. Lamarck Illustr. t. 825. (Ravensara; Sonnerat Ind. Occ. v. 2. 226. Euodia; Gært. t. 103. Lamarck Illustr. t. 404.)—Class and order, *Dodecandria Monogynia*. Nat. Ord. uncertain, perhaps akin to the *Lauri*, Juss.

Gen. Ch. *Cal.* Perianth inferior, very small, abrupt, entire, permanent. *Cor.* Petals six, ovate, inserted into the calyx, somewhat villous on the inside. *Stam.* Filaments twelve, broadish, very short, alternately inserted into the base of the petals and the inside of the calyx; anthers roundish. *Pist.* Germen superior, very small; style very short; stigma downy. *Peric.* Drupa nearly globose, umbilicated. *Seed.* Nut the shape of the drupa, tipped with a small abrupt point, divided internally half way, into six coriaceous cells; kernel convex above, six-lobed below, one lobe being received into each cell.

Eff. Ch. Calyx abrupt, entire. Petals six, inserted into the calyx. Drupa superior, nearly globose. Nut with six incomplete cells. Kernel foliary, with six lobes.

Obf. Schreber, by a casual oversight, describes the fruit as crowned with the calyx, though he justly terms the germen superior.

1. *A. aromaticum*. Willd. n. 1. (Ravensara aromatica; Sonnerat Ind. Or. v. 2. 226. t. 127. Euodia Ravensara; Gært. v. 2. 101.)—Native of Madagascar. A large and tufted, somewhat pyramidal tree, with a reddish aromatic bark, and heavy, hard, inodorous, white wood, intermixed with red fibres. Leaves alternate, stalked, simple, obovate, entire, generally obtuse; smooth on both sides; pale and rather glaucous beneath; single-ribbed, of a firm or coriaceous texture. Flowers very minute, numerous, in axillary panicles about the ends of the branches, shorter than the leaves. Fruit an inch in diameter, solitary at the end of each branch, so that, as Sonnerat remarks, one would think the flowers had grown on a different tree; the panicles being obliterated, probably, in consequence of one flower alone, in each, bearing fruit. The tree produces fruit at the age of five or six years, which is ten months in coming to perfection. The inhabitants of Madagascar gather it at the age of six or seven months, as being, in that state of growth, more fit for use as a spice. The kernel, when fresh, has a fine aromatic odour, but its taste is bitter, and so highly acrid as to burn the throat very disagreeably. The leaves are also very aromatic, and being made into a sort of garlands, are left for a month in the open air to dry; after which they are plunged, for four or five minutes, into boiling water, and then dried, either in the sun, or by a fire. The fruits are treated in the same manner. The flowers appear in January or February. The dried leaves, as well as the fruit, of this tree, are said to partake of the flavours of the four most esteemed spices. They have not, however, come into use as an article of commerce, though some of the French, resident in Madagascar, have endeavoured to call the attention of their countrymen to this object. Gærtner found the odour of the fruit, though agreeable, too weak to promise much utility.

RAVENSBERG, in *Geography*, a county of Germany, lying between the bishoprics of Munster, Osnaburgh, and Paderborn, the principality of Minden, and the counties of Schauenberg and Lippe. The soil is in some parts sandy, but in others, especially towards the principality of Minden, it produces corn, flax, and hemp; coal is found in some of the mountains, and good stone for building. Its name is derived from that of an ancient castle, and it had formerly its own counts. It lately belonged to the king of Prussia; but by the peace of Tilsit was transferred to the kingdom of Westphalia.

Westphalia. The approaching congress (1814) may possibly fix its future destination.

RAVENSBURG, a town of Bavaria, which anciently belonged to the Guelphs, counts of Altorf; but it was an imperial town before the time of king Rodolphus, and continued such till the year 1802, when it was given, among other indemnities, to the elector of Bavaria. The Roman Catholics and Lutherans are united with regard to the temporal and spiritual concerns of the place, and the magistracy is shared betwixt them. They have one church in common; but the Lutherans are exclusively possessed of another, and the Roman Catholics have also two parish-churches; 21 miles N.E. of Constance. N. lat. $47^{\circ} 41'$. E. long. $9^{\circ} 38'$.

RAVENSBURG, a town of the Rhenish palatinate, on the Elfsa; 16 miles W. of Heilbronn.

RAVENSBURN, a small stream of England, which runs into the Thames between Greenwich and Deptford.

RAVENSCROFT, THOMAS, in *Biography*, an active English musician and publisher, who flourished from the beginning of the 17th century to 1635. He was the editor and composer of the best collection of psalm tunes in four parts, which had till then appeared in England. He was a bachelor of music, and a professor not only well acquainted with the practice of the art, but seems to have bestowed much time in the perusal of the best authors, and in meditation on the theory.

This book, published in small octavo, 1621 and 1633, contains a melody for every one of the hundred and fifty psalms, many of them by the editor himself, of which a considerable number is still in use; as Windsor, St. David's, Southwell, and Canterbury. There are others, likewise, which are sung by the German, Netherlandish, and French Protestants. To these the base, tenor, and counter-tenor parts have been composed by twenty-one English musicians: among whom we find the names of Tallis, Dowland, Morley, Bennet, Stubbs, Farnaby, and John Milton, the father of our great poet. The tunes which are peculiar to the measure of the 100th psalm, the 113th, and 119th, were originally Lutheran, or perhaps of still higher antiquity. And though Ravenscroft has affixed the name of Dr. John Dowland to the parts which have been set to the 100th psalm, yet, in the index, he has ranked the melody itself with the French tunes; perhaps from having seen it among the melodies that were set to the French version of Clement Marot and Theodore Beza's Psalms, by Goudimel and Claude le Jeune. Ravenscroft, in imitation of these harmonists, always gives the principal melody, or, as he calls it, the *playn-song*, to the tenor. This part, indeed, he sometimes erroneously terms *Fa-burden*. This is a corruption of *faux-bourdon*, and *falso bordone*, which originally implied such simple harmony as arises from a series of thirds and sixths to the base. His publication is, in some measure, historical: for he tells us not only who composed the parts to old melodies, but who increased the common stock, by the addition of new tunes; as well as which of them were originally English, Welch, Scots, German, Dutch, Italian, French, and imitations of these.

No tunes of triple time occur in Claude le Jeune, and but five in Ravenscroft: the principal of which are Cambridge, Martyrs, Manchester, and the 81st. This last is still much used, and often played by chimes: it is called an imitation of a foreign tune, and has the name of Richard Allison prefixed to it. Muller's German edition of the psalm tunes at Frankfort is exactly that of Claude le Jeune, in two parts only; except that he has transposed some of the melodies, and inserted easy leading and connective notes, to assist, not only the singer, but sometimes the tunes them-

selves; which, without them, would now be very bald and uncouth. Many of these old melodies are still sung to German hymns as well as psalms.

In 1614 Ravenscroft published "*A briefe Discourse of the true, but neglected, Use of characterizing the Degrees by their Perfection, Imperfection, and Diminution in measurable Musick, against the common Practice and Custome of the Times,*" 4to.

Ravenscroft had been educated in St. Paul's choir, under Mr. Edward Pierce, and was particularly conversant with old authors; he, therefore, wished to revive the use of those proportions in time, which, on account of their intricacy, had been long discontinued.

Ravenscroft practised these exploded doctrines ineffectually, though to his Discourse he added examples to illustrate his precepts, expressed in the harmony of four voices, concerning the pleasure of the five usual recreations of hunting, hawking, dancing, drinking, and enamouring. He was not always very successful in his attempts at imitative harmony; and melody was then so crude and uncouth throughout Europe, as to afford little assistance in imitative strains.

Ravenscroft was also the author of a collection of songs, entitled "*Melcimata, Musical Phancies, fitting the Court, City, and Country Humours, in three, four, and five Voyces,*" published in the year 1611.

RAVENSCROFT, JOHN, one of the waits of the Tower Hamlets, and in the band of the Goodman's-fields playhouse, was a ripieno violin; yet, notwithstanding so humble a station, he was a performer of sufficient abilities to lead in any such band as that just mentioned; and could perform with great firmness a concerto of Corelli, or an overture of Handel. He was in great request at balls and dancing parties; but excelled most others, not only in *playing* hornpipes with the true sailor's *flang*, but in *composing* them: and there are two of his compositions, that a tar, if he had any leg to stand on, would irresistibly be impelled to dance, the moment he heard them.

RAVENSPUR, or **RAVENSER**, in *Geography*, was formerly a noted sea-port at the mouth of the Humber. It is celebrated by our historians for the descents of Henry IV. A.D. 1399, and of Edward IV. A.D. 1471, when these princes came to contend for the crown of England. It was shortly after, however, swallowed up by the ocean, together with many villages in its vicinity. The precise spot on which it stood is now unknown; but it is usually supposed to have been placed very near to Spurn Head, the Ocellum Promontorium of Ptolemy. For some additional account of the coast here, see PATRINGTON.

RAVENSTAIN, a town of Saxony, in the circle of Erzgebürg; 8 miles N.N.W. of Wolkenstein.—Also, a town of Hinder Pomerania; 7 miles E.S.E. of Zachan.

RAVESTEIN, a town of Brabant, on the S. side of the Meuse, the capital of a signiory, including 14 towns and villages; 15 miles N.E. of Bois le Duc.

RAVI, a name, in Sanscrit, of Surya, the Hindoo regent of the sun. It means the *Riser*, and has perhaps other meanings. See SURYA.

RAVIERES, in *Geography*, a town of France, in the department of the Yonne; 27 miles E. of Auxerre.

RAUJESHI, a circar of Bengal, bounded N. by Rajmahal, E. by Bettooriah, S. by Mahmudshih, Shahjole, and Kishenagur, and W. by Birboom and Hindooa; about 55 miles long, and 18 broad. The capital is *Moorshedabad*; which see.

RAVILLE, a town of France, in the department of the Moselle; 5 miles S. of Bouley.

RAVILLY, a small town of the county of Carlow, Ireland, in the barony of the same name. It is situated on the river Slaney, 3 miles S. from Balinglaff, and 32 S. by W. from Dublin.

RAVINA, a town of European Turkey, in Albania; 52 miles E. of Valona.

RAVINE, in *Field Fortification*, a deep hollow, usually formed by a great flood, or long continued running of water; frequently turned to good purposes in the field.

RAVIS, the same with *raucedo*. See HOARSENESS.

RAVISHMENT, in *Law*, denotes an unlawful seducing either a woman, or an heir in ward; for which there is a remedy by a writ of ravishment, or action of trespass *vi & armis, de filio vel filia rapto vel abducto*, in the same manner as the husband may have it *de uxore raptâ et abductâ*, on account of the abduction of his wife. This action lay at the common law; and thereby the husband shall recover, not the possession of his wife, but damages for taking her away: and by statute Westm. 1. 3 Edw. I. c. 13. the offender shall also be imprisoned two years, and fined at the pleasure of the king. Both the king and the husband may, therefore, have this action; and the husband is also entitled to recover damages in an action on the case against such as persuade and entice the wife to live separate from him, without a sufficient cause.

Sometimes it is also used in the same sense as *rape*; which see.

RAVISHMENT *de Gard*, is a writ which anciently lay, and still lies, for the guardian in socage against him who took from him the body of his ward, or pupil: but then he must account to his pupil for the damages he so recovers. It is expressly provided by statute 12 Car. II. c. 24. that testamentary guardians may maintain an action of ravishment, or trespass, for recovery of any of their wards, and also for damages, to be applied to the use and benefit of the infants.

RAVITZ, or RAWISCH, in *Geography*, a town of the duchy of Warsaw, most of the inhabitants of which are Lutherans: it has a considerable manufacture of cloth; 24 miles S. of Posen.

RAVIUS, or RAVE, CHRISTIAN, in *Biography*, a learned German Orientalist, was born at Berlin in the year 1613. From a very early period he was attached to the study of the eastern languages, and after spending eight years in different universities on the continent, he came over to England in the year 1658, and took up his residence at the university of Oxford. He brought with him recommendations from Vossius, and other learned men; and was invited to Dublin by archbishop Usher, primate of Ireland, who settled upon him a handsome stipend, and engaged him to take a voyage into the East, for the purpose of collecting ancient manuscripts. About the same time he was invited by cardinal Richelieu to enter into his employment for a similar purpose, which he declined, having already accepted the proposals of Usher. In 1639 he became acquainted with our countryman, the learned Edward Pococke, at Constantinople, where he improved himself in many languages, to which he had already applied his talents; and made himself master of the Turkish, Arabic, and Persian languages. In the mean time he did not neglect the main object of his mission, but collected more than 300 choice manuscripts. For this service he was, on his return, amply rewarded. In 1642 he taught the Oriental languages at Gresham college, in London. During the following year he went to Holland, and was appointed professor of the Oriental languages at Utrecht. We find him again in England in 1648, when he took the covenant, and was made

fellow of Magdalen college, Oxford, by the parliamentary visitors. In the course of a few months he left England, and went to Sweden, where he obtained the appointment of professor of the Oriental languages at the university of Upsal. This place he was obliged to leave about the year 1657; the revenues, that ought to have been devoted to the Upsal professors, having been applied towards defraying the expences of the war between Sweden and Denmark. After this he for some time filled the chair of Oriental literature at the university of Kiel, and from thence he removed to occupy the same professorship at Frankfort on the Maine. He died in 1677, about the age of 64. His works are very numerous, of which the following are titles of the principal: "Obtestatio ad universam Europam pro dicendis Rebus et Linguis Orientalibus, ac conjuganda Africæ atque Asiæ Eruditione," 1644; "Orthographiæ et Analogiæ vulgo Etymologiæ Ebraicæ Delineatio, juxta vocis partes abstractas;" "A Discourse of the Oriental Tongues, viz. Hebrew, Samaritan, Chaldee, Syriac, Arabic, and Ethiopic," 1649; "Concordantiarum Hebraicarum et Chaldaicarum Epitome;" "Chronologia Biblica nova;" "Epistolæ variae ad doct. Viros." He gave also to the world a translation, from the Arabic language, of Apollonius's Conic Sections. He had a brother, named John Ravius, who was professor of philosophy at Rostock, about the year 1638. In 1664-5 he was appointed counsellor and librarian to the elector of Brandenburg. He was author of "Commentarius in Cornelium Nepotem," 1635; "Summa Studiorum pro Nobilitate Danica;" "Aphorismi Militares," and other learned works.

RAULIN, JOHN, a French writer in the 15th century, was born at Toul in the year 1443. He pursued his studies at the university of Paris, where he obtained the degree of D.D. in 1480, and afterwards filled the professor's chair in theology with great distinction. He was elected grand master of the college of Navarre, and founded a good library in that seminary. Becoming dissatisfied with the world, he embraced the monastic life at the abbey of Cluny, in Burgundy, in 1497. He died in 1514, at the age of 71. He attracted much attention as a preacher, and several of his sermons have been published, which exhibit striking specimens of the bad taste which prevailed in France in the 15th century. The works of this author were collected, and published at Antwerp, in 6 vols. 4to., 1612. They are accompanied with a curious and valuable collection of "Letters," that illustrate the history, manners, and sentiments of the age in which he lived. They were first published after his death, in quarto, in 1521, under the title of "Joannis Raulin Epistolæ Illustrum Virorum." Moreri.

RAULT, FELIX, the favourite performer on the German flute at Paris, in 1770; where we heard him ourselves with as much pleasure as a flute can give, by neat execution, perfect intonation, and a mellifluous embouchure. M. Laborde has rendered his biographical article interesting by a detail of his professional merits and private character.

"M. Felix Rault was born at Bourdeaux, in 1736. He was the son of Charles Rault, of the king's band, and first balloon at the opera. Felix was received there in 1753, and in the king's band in 1768. His talents are so well known at Paris, as to be above praise. Since Blavet's time, no one has brought the art of playing upon the German flute to such perfection, especially in accompanying the voice; a much more difficult art than playing concertos of great execution, generally well studied at home previous to performance. But such study is useless to Rault; for no

one reads music more readily and with more facility, or gives it more meaning, than this performer. The beauty of his tone, the precision of his execution, the richness of his embouchure, however extraordinary, merit still less praise than his personal qualities, which endear him to all his acquaintance." Laborde.

RAUMO, in *Geography*, a sea-port town of Sweden, in the province of Finland, on the E. coast of the gulf of Bothnia; 50 miles N. of Abo.

RAUNPIKED, in *Rural Economy*, a provincial word used to signify flag-headed, among trees, as an old overgrown oak, having the stumps of the boughs standing out.

RAURAH, in *Geography*, a town of Thibet; 26 miles N. of Jemlah. N. lat. $31^{\circ} 2'$. E. long. $81^{\circ} 40'$.

RAURAVA, a Sanscrit word meaning *dreadful*, and a name of one of the Hindoo hells; they reckoning twenty-one of these receptacles for sinners. Naraka is called Mahaurava, or most dreadful.

RAURIS, in *Geography*, a town of the archbishopric of Salzburg; 32 miles S. of Salzburg.

RAUSCHENBERG, a town of Hesse; 4 miles N. of Marburg. N. lat. $50^{\circ} 53'$. E. long. $8^{\circ} 53'$.

RAUSHENBERG, a town of Germany, in the principality of Culmbach; 7 miles N.N.E. of Neustadt.

RAUSNITZ, a town of Moravia, in the circle of Brunn; 10 miles E. of Brunn.

RAUTA LAMBI, a town of Sweden, in the government of Kuopio; 27 miles S.W. of Kuopio.

RAUTENBURG, a town of Prussian Lithuania; 27 miles W. of Tilsit.—Also, a town of Prussia, in the province of Samland; 36 miles N.E. of Königsberg.

RAUTERN, a town of Austria; 6 miles W.N.W. of Drosendorf.

RAUTIO, a town of Sweden, in the government of Ulea; 36 miles S. of Brahestad.

RAÛTPOUR, a town of Hindoostan, in Allahabad; 18 miles N.N.W. of Corah.

RAUTY DUNGAREE, a town of Hindoostan, in Guzerat, on the coast; 50 miles S.W. of Noanagur.

RAUTY-Mummy, or *Rauty-muddum, stone-mummy*, a name given by the people of the East Indies to a kind of fossil substance, much valued for its medicinal virtues. It is of the nature of the felenites, and is found upon the high rocks, and supposed to be generated of the dew which falls from the heavens; but this is an idle opinion, and the formation of it is evidently the same with that of the European rhomboidal felenites. They beat it to powder, and after boiling it in milk, they give it in cases of the venereal kind. In a common clap, they give half a scruple, night and morning.

RAUVEE, in *Geography*, a river of Asia, which rises on the borders of Thibet, and joins the Chunaub in the country of Lahore, 28 miles N.E. of Moulton. The Rauvee is the "Hydraotes" of Alexander, and though it is represented as a noble river, it is somewhat inferior in bulk to the Chunaub. Its sources are in the mountains near Nagorkote, a famous place of Hindoo worship; and it enters the plains near Shahpour (called also Rajapour), from whence the famous canal of Shah Nahr was drawn to Lahore, $48\frac{1}{2}$ common cossees in length. The space between the Rauvee and Chunaub, at their entry on the plains, is about 54 geographical miles; and they gradually approach each other during a course of 170 miles. The junction of the Rauvee with the Chunaub (or rather the Chunaub and Behut collectively) is effected nearly midway between Toulumba and Moulton. The Ayin Acbaree allows 27 cossees between the junction of the Behut

and Chunaub, and that of the Rauvee with the Chunaub; but this distance must be applied to the course of the river, not to the road by land. When these three rivers are united, they form a stream equal to the Indus itself, at the place of confluence; which is from 20 to 30 miles below Moulton. Rennell.

RAUWOLFIA, in *Botany*, was so named by Plumier, in memory of Leonard Rauwolf, a native of Augsburg, and a pupil of Rondelet. He sailed from Marseilles, in 1573, for the Levant, and performed a laborious and dangerous journey through Syria, Mesopotamia, Palestine and Egypt; of which he has left an account in German, full of curious information relative to medical and other rare plants, with several wooden cuts. He died physician to the Austrian army, at Hatvany, in Hungary, in 1606, according to Dryander, Bibl. Banks. v. 395, though Haller says 1596. The latter writer mentions his being obliged to quit his country on account of his religion, which was Protestant. His splendid herbarium, once the property of queen Christina, and of Isaac Vossius, is preserved in the university of Leyden. From it Gronovius composed his *Flora Orientalis*.—Linn. Gen. 115. Schreb. 160. Willd. Sp. Pl. v. 1. 1217. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 2. 64. Juss. 148. Plum. Gen. 19. t. 40. Lamarck Illustr. t. 172. Gærtn. t. 52.—Class and order, *Pentandria Monogynia*. Nat. Ord. *Contortæ*, Linn. *Apocineæ*, Juss.

Gen. Ch. Cal. Perianth inferior, minute, with five segments, permanent. Cor. of one petal, salver-shaped; tube cylindrical, globular at the base; limb in five deep, roundish, emarginate, oblique segments. Stam. Filaments five, shorter than the tube; anthers erect, simple, acute. Pist. Germen roundish; style very short; stigma capitate. Peric. Berry nearly globose, marked with a furrow along one side, of one cell. Seeds two, convex at the base, tapering at the summit, compressed, divided, more or less completely, into two cells.

Ess. Ch. Corolla oblique, salver-shaped. Stamens included. Berry globose, with two seeds, each of two cells.

1. *R. nitida*. Shining Rauwolfia. Linn. Sp. Pl. 303. Hort. Cliff. 75. t. 9. Willd. n. 1. Ait. n. 1. (*R. tetraphylla angustifolia*; Plum. Ic. 232. t. 236. f. 1.)—Leaves in fours, lanceolate, pointed, very smooth and shining. Flowers axillary or terminal, cymose.—Native of mountainous woods in the West Indies. A shrub about twelve feet high, erect, very smooth and shining, abounding with viscid milk. Leaves four together at each joint of the branches, spreading, on short stalks, lanceolate, with a blunt point, entire, unequal in size, from two to five inches, or more, with one rib, and many fine transverse parallel veins. Flowers small, white, inodorous, in axillary, rarely terminal, stalked cymes, shorter than the leaves. Fruit, according to Jacquin, at first yellow, then purplish-black, thrice the size of a pea, milky. Linnæus tells us his figure in the Hortus Cliffortianus was drawn by Ehret, from a plant in the Chelsea garden; so that this *Rauwolfia* must have flowered under Miller's care, in the year 1736. In Ait. H. Kew. a later date is given. The corolla in the figure just mentioned is more concave in the limb, as well as more notched, than Plumier represents it.

2. *R. glabra*. Smooth Rauwolfia. Cavan. Ic. v. 3. 50. t. 297. Willd. n. 2.—Leaves alternate, ovato-lanceolate, smooth. Cymes opposite to the leaves, of few flowers.

Native of New Spain. The whole plant is smooth. Stem shrubby, a yard high, with plant, round, leafy branches. Leaves scattered, rounded at the base, rather pointed, single-ribbed, two or three inches long, on shortish footstalks. Flowers small, white, about four together, in small cymes or clusters,

clusters, opposite to the leaves. *Berry* obovate, with only one seed; at least in garden specimens, which very probably differ in those respects from wild ones. This species flowered at Madrid from August to October.

3. *R. canescens*. Hoary Rauwolfia. Linn. Sp. Pl. 303. Willd. n. 3. Ait. n. 2. (*R. hirsuta*; Jacq. Amer. 47. *R. tetraphylla latifolia*; Plum. Ic. 232. t. 236. f. 2.)—Leaves in fours, elliptic-obovate, acute, downy. Flowers axillary or terminal. Segments of the corolla obtuse.—Native of dry, sunny, bushy places in the West India islands, as well as on the neighbouring continent. It was cultivated by Miller at the same time with the first species. We received a specimen in flower, from the stove at Kew, in June 1807. Jacquin says this species varies greatly in the size of all its parts, according to soil and situation, and in the height of its stem from one to eight feet. The young branches, flower-stalks, footstalks, and both sides of the leaves, are clothed with short dense pubescence, which almost entirely disappears by culture, though the upper side of the footstalks continues rough with bristly glands. The leaves are from one and a half to two inches long, obovate, more or less inclining to elliptical, acute, unequal. Flowers in small, axillary, downy, stalked tufts, or umbels. Corolla green with a tinge of red, its segments obtuse. Fruit cloven at the top, first red, then black, containing two seeds, as Jacquin well describes it. One cell of each seed is usually, according to him, abortive.

4. *R. tomentosa*. Downy Rauwolfia. Jacq. Amer. 48. Obf. fasc. 2. g. t. 35.—Leaves in fours, obovato-lanceolate, downy, tapering at each end. Flowers axillary or terminal. Segments of the corolla acute.—Native of rocky places about Carthage; sometimes on the stone walls of the town. Jacquin alone seems to have known this species, which principally differs from the last, as far as we can judge, in having white flowers, the segments of whose corolla are ovate and acute. The leaves moreover are rather tapering at each end; but that circumstance varies. Fruit the size of a pea, first red, then black. We have seen no specimen.

5. *R. Pulparia*. East Indian Rauwolfia. Roxb. MSS.—Leaves in threes, elliptical, bluntly pointed, smooth and shining. Flowers terminal, in forked panicles. Corolla many times longer than the calyx. Sent by Dr. Roxburgh, from Calcutta, with the above name. We rely on him for the genus, having seen no fruit. This shrub is smooth in nearly every part, with round branches. Leaves about three inches long, and above one broad, coriaceous and shining; their transverse veins very fine and numerous. Flower-stalks very minutely downy, as well as the imbricated bractes, and keeled pointed segments of the calyx. Corolla apparently white, with a red tube, which is near three quarters of an inch long, cylindrical, swelling at the top: segments of the limb rounded.

RAUWOLFIA, in *Gardening*, contains plants of the tender, exotic, shrubby kind for the stove, of which the species cultivated are: the shining rauwolfia (*R. nitida*); and the hoary rauwolfia (*R. canescens*).

Method of Culture.—These may be increased by the seeds or berries, which should be sown in pots filled with light mould, in the autumn or spring, plunging them in a mild hot-bed. When the plants have attained some growth, they should be removed into separate pots, and have the management of other exotic stove plants. They may likewise be raised by layers and cuttings, laid down or planted out in pots, plunged in the hot-bed in the spring and summer months, till they have thickened root, being afterwards managed as those from seed.

They afford much ornament and variety in hot-house collections, both in their foliage and flowers.

RAUZAN, in *Geography*, a town of France, in the department of the Gironde; 9 miles S.S.E. of Libourne.

RAUZZINI, VENANZIO, in *Biography*, a native of Italy, who, when he arrived here in 1774, to succeed Millico at the opera, was a beautiful and animated young man, with a soprano voice. He was an excellent musician, having studied counterpoint with as much application as the art of singing: so that he may truly be said not only to know his own business, but that of a maestro di cappella; having been as able to compose an opera as to perform a principal part in it. “*Piramo e Tisbe*,” and “*La Vestale*,” may be instanced in proof of this assertion.

His voice was not very powerful when he came hither from Munich, where we first knew him; and where he had enjoyed the highest favour several years. His taste, governed by science, was correct and exquisite. His voice, though not of great volume, was sweet, clear, flexible, and extensive; being in compass more than two octaves. But he is supposed to have injured his chest in early youth by a rage for counterpoint. He played the harpsichord neatly, accompanied well, and had real genius for composition, which inclined him to devote that time to the pen and the improvement of his hand, which, perhaps, in his station, would have been more usefully bestowed in nursing and exercising his voice.

It was some time before the extent of his merit and science were known in this country, and favoured by the public. Nothing can so speedily convey the merits of a singer to an audience, as a great and powerful voice. However, his taste, fancy, knowledge, and delicacy, together with his beautiful person, and spirited and intelligent manner of acting, before the first season was over, gained him general approbation and favour. And since he has quitted the stage, and made Bath his residence. Though he has been long obliged to discontinue singing in public, it is not too much to say that he has disseminated good taste throughout the kingdom, by the numerous scholars he has taught among the nobility and gentry, as well as by those whom he has prepared for public patronage, professionally.

RAW, in *Agriculture*, any sort of plant, substance, or material, which is in a green, unripe, or undigested condition, or which is employed in its more fresh and crude state; as, for instance, dung before it has been much reduced, and lost many of its nutrient principles or properties by the process of fermentation. See DUNG.

RAW Cream, in *Rural Economy*, such as is raised in the natural way, not scalded or clouted.

RAW Hide. See HIDE.

RAW Lands, in *Agriculture*, a term applied to wet, cold, heavy lands, which are unfit to receive the feed.

RAW Silk. See SILK.

RAWA, or RAVA, in *Geography*, a town of the duchy of Warsaw, late capital of a palatinate of the same name. The castle is appropriated for the confinement of state prisoners; 45 miles S.W. of Warsaw. N. lat. 51° 55'. E. long. 20° 17'.

RAWA, a town of Poland, in the palatinate of Belz; 18 miles S.W. of Belz.

RAWA. See RAVA.

RAWAK, a small island in the Pacific ocean, near the N. coast of the island of Waygoo, with which it forms a harbour. E. long. 131° 15'.

RAWAPSKITCHWOCK, a small westerly branch of Machias river. See MACHIAS.

RAWAY, or Bridge-town, a truly commercial village of Middlesex county, New Jersey, on Raway river, four or five miles S.W. of Elizabeth-town, and 75 from Philadelphia.

phia. It contains a post-office, a presbyterian church, and about 50 or 60 houses.

RAWDON, a town of Nova Scotia, 40 miles from Halifax, containing about 50 or 60 houses.

RAWDON, a township of the county of Halkings, in Upper Canada, N. of Sidney.

RAWLINSON, CHRISTOPHER, in *Biography*, of Cork-Hall, in Lancashire, was born in 1677, educated in Queen's college, Oxford, and died in 1733: he was much attached to Saxon and Northern literature, and published an edition of "King Alfred's Translation of Boethius de Consolatione," 8vo. 1698.

RAWLINSON, RICHARD, a distant relation of the preceding, a learned antiquarian, was the son of Sir Thomas Rawlinson, knight, and once lord mayor of London. He was educated at St. John's college, Oxford, and was admitted to the degree of doctor of the civil law in 1719. He devoted himself to antiquarian pursuits, and made large collections for a continuation of Wood's *Athenæ Oxonienses*, and History of Oxford, and published the life of that industrious antiquary. The principal work of Mr. Rawlinson was "The English Topographer," or, An historical account of all the pieces that have been written relating to the ancient natural history or topographical description of any part of England, 1720. He published the "Latin Letters of Abelard and Heloise," and "A Translation of Du Fresnoy's New Method of Studying History," 2 vols. 8vo. He died at Islington in 1755, and by his will ordered that his heart should be deposited in the chapel of St. John's college, Oxford. That university was indebted to him for various benefactions of books, manuscripts, medals, &c. as well as landed property, and an endowment for an Anglo-Saxon lecture.

RAWLOW, in *Geography*, a town of Hindoostan, in Palnaud; 27 miles W.S.W. of Timerycotta.

RAY, JOHN, in *Biography*, whom Haller terms the greatest botanist in the memory of man, and to whose transcendent merits we have already briefly adverted, in treating of the genus dedicated by Plumier to his name, see RAJANIA; was born at Black Notley, near Braintree, in Essex, Nov. 29, 1628. His father, Roger Ray, though in the humble station of a blacksmith, gave him a learned education; first at the grammar-school of his native town, at that time not very well conducted; and subsequently at Cambridge, where he entered at Catharine Hall, in his 16th year, June 28th, 1644, being designed for holy orders. In about a year and three quarters afterwards, he removed to Trinity College, where he found the young men occupied in a more liberal train of studies, with less of scholastic disputations and quibbles. Ray was fortunate in having for his tutor at Trinity, Dr. Duport, an eminent Greek scholar, under whose fostering and partial care, he soon made up for all the deficiencies of his early education, in the learned languages, including Hebrew. By this gentleman he was always mentioned with peculiar regard. He was no less happy in a youthful literary friend and fellow-student, afterwards the celebrated Dr. Isaac Barrow. Even at this early period, Ray began to cultivate natural history; and distinguished himself by many school exercises as an orator, no less than by his general taste for study, his love of virtue, and his gentleness of manners, qualities which shone brighter and brighter to the latest period of his life. His merit occasioned him to be chosen a Minor Fellow of Trinity, along with his friend Barrow, September 8th, 1649. On taking his degree of Master of Arts, he became a Major or Senior Fellow; and afterwards, October 1st, 1651, Greek Lecturer of the college. At the end of two years he was ap-

pointed Mathematical Lecturer, and in two years more, October 2d, 1655, Humanity Reader. He subsequently filled several respectable offices in his college, as Junior Dean, College Steward, &c., and during his residence in the university, became tutor to many gentlemen of rank and fortune, who were sensible of their obligations to him; amongst whom the most eminently distinguished by personal worth, and congeniality of talents with himself, was Mr. Francis Willughby, of Middleton-hall in Warwickshire, so well known by his posthumous works on Birds and Fishes, edited by the affectionate care of Ray.

At this period it was usual for young men of ability and learning, though not in orders, to deliver sermons, and common-place readings, as they were called; not only in the chapels or halls of their own colleges, but even before the university body, at St. Mary's church. In these Ray eminently distinguished himself. He was among the first who ventured to lead the attention of his hearers, from the unprofitable subtleties of scholastic divinity, and the trammels of Aristotelian philosophy, to an observation of nature, and a practical investigation of truth. The rudiments of many of his subsequent writings originated in these juvenile essays, particularly his celebrated book on the "Wisdom of God manifested in the Works of the Creation," known all over the world by its numerous editions and translations, and universally admired for its rational piety, sound philosophy, and solid instruction. This book is the basis of all the labours of following divines, who have made the book of nature a commentary on the book of revelation; a confirmation of truths, which Nature has not authority, of herself, to establish. In it the author inculcates the doctrine of a constantly superintending Providence; as well as the advantage, and even the duty, of contemplating the works of God. This, he says, is part of the business of a sabbath day, as it will be, probably, of our employment through that eternal rest, of which the sabbath is a type. Archbishop Tennison is recorded to have told Dr. Derham, that "Mr. Ray was much celebrated, in his time, at Cambridge, for preaching solid and useful divinity, instead of that enthusiastic stuff, which the sermons of that time were generally filled with." Two of his funeral discourses are mentioned with particular approbation; one on the death of Dr. Arrowsmith, master of his college; the other on that of one of his most intimate and beloved colleagues, Mr. John Nid, likewise a Senior Fellow of Trinity, who had a great share in Ray's first botanical publication, the *Catalogus Plantarum circa Cantabrigiam nascentium*, printed in 1660; which may be considered as the prototype of his *Synopsis*, hereafter mentioned. Indeed before this little volume appeared, its author had visited various parts of England and Wales, for the purpose of investigating their native plants, as he did several times afterwards; nor were his observations confined to natural history, but extended to local and general history, antiquities, the arts, and all kinds of useful knowledge. His amusing Itineraries were published, along with his life, by Dr. Derham, and a few letters to that gentleman, by the care of Dr. George Scott, F.R.S., in 1760, under the title of "Select Remains of the learned John Ray, M.A., &c." Ray's first botanical tour occupied nearly six weeks, from August 9th to September 18th, 1658. On the 23d of December 1660, he was ordained, both deacon and priest at the same time, by Dr. Sanderfon, then bishop of Lincoln. In 1661 he travelled with Mr. Willughby into Scotland, returning by Cumberland and Westmoreland; and the following year, with the same companion, he accomplished a more particular investigation of Wales. How critically he studied the botany of the countries

countries he visited, is evident from the different editions of his *Catalogus Plantarum Angliæ*, and *Synopsis Methodica Stirpium Britannicorum*.

All this while Mr. Ray continued to enjoy his fellowship, and to cultivate his Cambridge connections; but in September 1662, his tranquillity was disturbed by the too famous Bartholomew act, by which 2000 conscientious divines were turned out of their livings, and many fellows of colleges deprived of their maintenance, and means of literary improvement. Among the latter was the subject of our memoir, with thirteen honest men at Cambridge besides, of whose names he has left us a list. "One of them, Dr. Dillingham, was master of Emanuel college; but Ray was the only person of his own college who suffered this deprivation. The reader must not suppose that he, or perhaps any other person in this illustrious catalogue, was, in the least degree, deficient in attachment to the doctrine or discipline of the church of England, or that they had taken the oath called the Solemn League and Covenant; which Ray certainly had neither taken nor ever approved. They were required to swear to the infamous proposition, that the said oath was not binding to those who had taken it, and on this ground they conscientiously gave up their preferment. It is curious to read the apology made for Ray to Dr. Derham, on this subject, by a Mr. Brokesby—"that he was at that time absent from his college, where he might have met with satisfaction to his scruples; and was among some zealous non-conformists, who too much influenced him, by the addition of new scruples. And we may also ascribe somewhat to the prejudice of education in unhappy times." By this it appears, that the "scruples" of non-conformists were most favourable to the sanctity of an oath; and that the "unhappy times" alluded to, were more advantageous to principle, than the golden days of Charles II.; whose ministers doubtless valued the obedience, far more than the honesty, of any man; nor is this taste, by any means, peculiar to them or their profligate master.

Mr. Ray, or, as he wrote his name, for a while, about this period, Wray, having thus the world before him, made an arrangement with Mr. Willughby for a tour on the continent; and in this plan two of his pupils were included, Mr. Nathaniel Bacon, and Mr., afterwards sir Philip, Skippon. They sailed for Calais in April 1663, but being prevented, by the state of political affairs, from prosecuting their journey through France, they traversed the Low Countries, Germany, &c. proceeding by Venice into Italy; most of whose cities they visited, either by sea or land; as well as Malta and Sicily; and returned, by Switzerland, through France, into England, in the spring of 1666. Mr. Willughby indeed separated from the rest of the party at Montpellier, and visited Spain. An ample account of their observations was published by Ray, in 1673, making a thick octavo volume. The travellers appear to have been diligent and acute in every thing relative to politics, literature, natural history, mechanics, and philosophy, as well as antiquities and other curiosities; but in the fine arts they assume no authority, nor display any considerable taste or knowledge. Mr. Willughby's account of Spain makes a part by itself; and a rich critical catalogue of such plants, not, for the most part, natives of England, as were observed in this tour, concludes the volume. Haller gives to Ray the credit of having discovered several species in Switzerland, previously not known as natives of that country.

Ray passed the summer of 1666 partly at Black Notley, and partly in Sussex, studying chiefly the works of Hook, Boyle, Sydenham on Fevers, and the Philosophical Transactions, "making few discoveries," says he, "save of mine

own errors." The following winter he was employed at Mr. Willughby's, in arranging that gentleman's museum of natural history and coins, and in forming tables of plants and animals for the use of Dr. Wilkins, in his famous work on a Universal Character. He now also began to arrange a catalogue of the English native plants, which he himself had gathered; rather for his own use, than with any immediate view of publication; "at present," as he wrote to Dr. Lister, "the world is glutted with Dr. Merret's bungling Pinax. I resolve never to put out any thing which is not as perfect as is possible for me to make it. I wish you would take a little pains this summer about grasses, that so we might compare notes." The above resolution of our author is, no doubt, highly commendable, but the world has rather to lament that so many able men have formed the same determination, at least in natural science. If it were universally adhered to, scarcely any work would see the light; for few can be so sensible of the defects of any other person's attempt to illustrate the works of nature, as a man of tolerable judgment must be of his own. This is especially the case with those who, like Ray, direct their aspiring views towards system, and philosophical theory. Happily he did not try this arduous path, till he had trained himself by wholesome practical discipline, in observation and experience. His first botanical works assumed the humble form of alphabetical catalogues. His and Mr. Willughby's labours in the service of bishop Wilkins, were indeed of a systematical description; and accordingly the authors themselves were, more than any other person probably, dissatisfied with their performance. They relaxed from these labours in a tour of practical observation through the west of England, as far as the Land's-End, in the summer of 1667, and returning by London, Mr. Ray was solicited to become a Fellow of the Royal Society, into which learned body he was admitted November 7th. Being now requested by his friend Wilkins to translate the "Real Character" into Latin, he undertook, and by degrees accomplished, that arduous performance, depositing his manuscript in the library of the Royal Society, where it has ever since reposed. The following summer was agreeably spent, in visits to various literary friends, and in a solitary journey to the north; for his former companion Willughby, being just married, stayed at home; there Ray joined him in September 1668, and remained for most part of the ensuing winter and spring.

The seclusion and leisure of the country, with the converse and assistance of such a friend, were favourable to the prosecution of a new subject of enquiry, which now strongly attracted the attention of our great naturalist, the theory of vegetation. The first step of the two philosophers, in this little-explored path, was an examination of the motion of the sap in trees; and the result of their enquiries, communicated to the Royal Society, appeared soon after in the Philosophical Transactions. Their experiments clearly prove the ascent of the sap through the woody part of the tree; which is easily detected by boring the trunk, at different depths, before the leaves are unfolded; and they observed also the mucilaginous nature of the flowing sap, "precipitating a kind of white coagulum or jelly, which," says Ray, in a note preserved by Derham, "may be well conceived to be the part which, every year, between bark and tree, turns to wood, and of which the leaves and fruit are made. It seems to precipitate more when the tree is just ready to put out leaves, and begins to cease dropping, than at its first bleeding." The accuracy of the leading facts recorded by these ingenious men, is confirmed by subsequent observers, who have further pursued the same subject, which is now sufficiently

sufficiently well understood. They indeed, like the rest of the world till lately, seem not to have suspected, that the sap was quiescent till their perforations in the tree were made; nor did they advert, as they ought, to phenomena dependent on the principle of life, in the vegetable body. See *CIRCULATION of the Sap*.

At this time Ray began to prepare for the press his "Collection of Proverbs," a curious book in its way, by which he is perhaps better known to the generality of his countrymen, than by any other of his literary labours. The first edition was published in 1672; but the work was subsequently much enlarged, and the author may almost be said to have exhausted his subject. From its very nature, delicacy and refinement must often be dispensed with; but this is evidently not the fault, or the aim, of the writer. His learning and critical acuteness diffuse light over the whole, and make us overlook the coarse vehicle of our instruction.

The first edition of the Catalogue of English Plants, already mentioned, came out in 1670, and the second in 1677. Their great author gave his work to the world with that diffidence, for which he alone perhaps could perceive any just foundation. We postpone our remarks till we speak of the same work in its systematic form hereafter.

About this period the health of Mr. Ray seems to have been considerably impaired. He refused a tempting offer to travel again on the continent, as tutor to three young noblemen; nor could the powerful attractions of alpine botany, which made a part of his prospect, overcome the reluctance to leaving home, which arose from a feeble state of body. Indeed this very reluctance, or listlessness, is accounted for, by the turn which his disorder took, as it terminated in the jaundice. After this depressing complaint had left him, he resumed, with fresh alacrity, his botanical travels at home, visiting the rich stores of the north of England, with a companion named Thomas Willughby, whose name and discoveries he afterwards, on many occasions, has gratefully commemorated. Nothing forms a more striking feature in Ray's character, than the unreserved and abundant commendation, which he always gave to his friends and fellow-labourers. We are about to narrate an event, which called forth all his affectionate feelings of this kind, as well as his most important and beneficial exertions; when, even to his own prejudice, he fulfilled the sacred duties of friendship, and delighted in adorning the bust of his friend with wreaths, that he himself might justly have assumed. On the 3d of July 1672, Mr. Willughby was unexpectedly carried off by an acute disorder, in the 37th year of his age. The care of his two infant sons was confided by himself to Mr. Ray, who was also appointed one of his five executors, and to whom he left an annuity of 60*l.* for life. The eldest of these youths was created a baronet at the age of 10 years, but died before he was 20. Their sister Cassandra afterwards married the duke of Chandos. Thomas, the younger son, was one of the ten peers created, all on the same day, by queen Anne, and received the title of lord Middleton. His early youth was much indebted to the care of his faithful guardian, who composed, for his and his brother's use, and published in 1672, a *Nomenclator Classicus*, far more exact, especially in the names of natural objects, than any that had previously appeared. The care of his pupils, and of the literary concerns of their deceased parent, now interrupted Mr. Ray's botanizing excursions, and caused him also to decline the offer of Dr. Lister, then a physician at York, to settle under his roof. Bishop Wilkins did not long survive Mr. Willughby, and his death made another chasm in the scientific and social circle of our

great natural philosopher, who felt these losses as deeply and tenderly as any man. He sought consolation in a domestic attachment, fixing his choice on a young woman, of good parentage, whose name was Margaret Oakeley, and who resided in the family at Middleton-hall. He was married at the parish church, June 5th, 1673, being then in the 45th year of his age, and his bride about 20. This lady took a share in the early education of his pupils, as far as concerned their reading English. She is said to have been recommended by her character, as well as her person, to the regard of her husband. She bore him three daughters, who, with their mother, survived him.

Ray's communications to the Royal Society became now very frequent, and extended to various subjects relative to the natural history of animals, as well as to the physiology, and even the botanical characters, of vegetables. He was, at the same time, in the course of the years 1674 and 1675, much occupied in digesting Mr. Willughby's zoological papers. These were composed in Latin, in which language the Ornithology first appeared in 1676, making a folio volume, accompanied by 77 plates, engraved, at the expence of the author's widow, from his own drawings. An English translation by Ray, with still more additions than he had supplied to the former publication, and one more plate, issued from the press in 1678. The account which Dr. Derham received from the lips of Mr. Ray, about eight months previous to his decease, respecting the primary intentions of himself and his late friend, and which is recorded in his life, p. 48, is too curious to be omitted here, as their project and its execution form an epocha in the history of natural science. "These two gentlemen," says Derham, "finding the history of Nature very imperfect, had agreed between themselves, before their travels beyond sea, to reduce the several tribes of things to a method; and to give accurate descriptions of the several species, from a strict view of them. And so far as Mr. Willughby's genius lay chiefly to Animals, therefore he undertook the Birds, Beasts, Fishes, and Insects, as Mr. Ray did the Vegetables." Derham adds, that Mr. Willughby, during his short life, "prosecuted his design with as great application, as if he had been to get his bread thereby." The writer of the present article has elsewhere observed, (*Introductory Discourse, Tr. of Linn. Soc. v. 1.*) that "from the affectionate care with which Ray has cherished the fame of his departed friend, we are in danger of attributing too much to Mr. Willughby, and too little to himself." His own statement, no doubt, was correct, as to their original aims; but it is impossible not to perceive that the survivor executed or perfected what his friend, in many instances, could only have projected, or scarcely begun. Had Willughby lived, there can be little doubt of his career being as glorious in the sequel as that of his friend; and possibly, from the advantages of fortune which he enjoyed, even more widely beneficial to science. Yet who can tell that he might not have slackened his course? Though he gloriously avoided the snares of luxury and folly in his youth, who shall say that politics or ambition might not have dazzled his riper age? or that he would always have escaped that ruinous vanity, which grasps at universal knowledge, or rather at universal fame; and knowing nothing deeply, is most flattered with any praise which is least deserved. So often has this last been the case with literary men, that one cannot but mistrust a character of the fairest promise. What Ray has done, we know and can appreciate. Equal to his friend in learning, talents, and zeal, the advantages of ample fortune were compensated by the leisure and tranquillity of a sequestered country life. His duties

went hand in hand with his studies and recreations, and he enjoyed, as Haller observes, the rare felicity of giving 50 years uninterruptedly to his favourite science. His long-protracted studies, and ripened experience, enabled him to achieve what at first he could but regard at a distance, as the great object of his wishes, a systematic arrangement of the animal as well as vegetable kingdoms. Every body had, hitherto, been content with Aristotle's classification of animals, of whose imperfections Ray, daring to think for himself, could not but be aware. He invented a new one, founded on the structure of the heart. "The Harveian experiments, and doctrine of the circulation, had called the peculiar attention of philosophers to every organ which has a share in that phenomenon; and to this cause, probably, we owe the method of Ray." The mode of breathing in animals, whether by lungs or by gills, and the single or double structure of the heart, in the former case, constitute the basis of his system; which, in these particulars at least, succeeding naturalists have adopted. His subordinate characters of the principal classes evince great skill and sagacity, and the Linnæan system of Quadrupeds is highly indebted to that of our illustrious countryman.

His zoological publications indeed did not follow each other in rapid succession; for after the Ornithology had come forth in English, eight years elapsed before the *Hystoria Piscium* of Willughby was given, by his care, to the world. This was printed in folio, with 188 plates of fishes, in 1686, at Oxford, owing to the interest of bishop Fell, and the pecuniary assistance of the Royal Society. It does not appear why the relict of Mr. Willughby withheld, in this instance, the contributions which had so much benefited her husband's former work, and which she justly owed to his fame. It seems that the intimate connexion of Ray with this family, was much impaired by the death of lady Cassandra Willughby, the mother of his friend, about the year 1675 or 1676; when the children were taken from his tuition, and he left Middleton-hall, fixing for a short time at Sutton Cofeld, four miles distant. At Michaelmas 1677 he removed from thence to Falborne-hall, in Essex, not far from his native village. On the 15th of March following, his mother, at the age of 78, died at Black Notley, "in her house on Dewlands;" of whom he speaks with that reverence and regret, which has peculiarly marked the characters of some of the greatest and best men on the same occasion. At Midsummer 1679, he finally settled at Black Notley, for the remainder of his days, or "for the short pittance of time he had yet to live in this world," as he himself expressed it; which pittance, however, extended to more than twenty-five years.

The first fruit of our author's leisure and retirement was his *Methodus Plantarum Nova*, published in 1682, making an octavo volume. His principles of arrangement are chiefly derived from the fruit. The regularity and irregularity of flowers, which take the lead in the system of Rivinus, make no part of that of Ray. It is remarkable that he adopts the ancient primary division of plants, into trees, shrubs, and herbs, and that he blamed Rivinus for abolishing it, though his own prefatory remarks tend to overset that principle, as a vulgar and casual one, unworthy of a philosopher. That his system was not merely a commodious artificial aid to practical botany, but a philosophical clue to the labyrinth of Nature, he probably, like his fellow-labourers, for many years, in this department, believed; yet he was too modest, and too learned, to think he had brought this new and arduous design to perfection; for whatever he has incidentally or deliberately

thrown out, respecting the value of his labours, is often marked with more diffidence on the subject of classification, than any other. He first applied his system to practical use in a general *Hystoria Plantarum*, of which the first volume, a thick folio, was published in 1686, and the second in 1687. The third volume of the same work, which is supplementary, came out in 1704. This vast and critical compilation is still in use as a book of reference, being particularly valuable as an epitome of the contents of various rare and expensive works, which ordinary libraries cannot possess, such as the *Hortus Malabaricus*. The description of species is faithful and instructive; the remarks original, bounded only by the whole circuit of the botanical learning of that day; nor are generic characters neglected, however vaguely they are assumed. Specific differences do not enter regularly into the author's plan, nor has he followed any uniform rules of nomenclature. So ample a transcript of the practical knowledge of such a botanist, cannot but be a treasure; yet it is now much neglected, few persons being learned enough to use it with facility, for want of figures, and a popular nomenclature; and those who are, seldom requiring its assistance. A mere catalogue or index, like the works of Tournefort and Caspar Bauhin, which teach nothing of themselves, are of readier use. The *Species Plantarum* of Linnæus unites the advantages of the clearest most concise specific definition, and, by the help of Bauhin, of an universal index.

But if the fame or the utility of Ray's great botanical work has, neither of them, been commensurate with the expectations that might have been formed, a little octavo volume, which he gave to the world in 1690, amply supplied all such defect, and proved the great corner stone of his reputation in this department of science. We speak of the *Synopsis Methodica Stirpium Britannicarum*. The two editions of his alphabetical catalogue of English plants being sold off, and some pettifoggish reasons of his bookseller's standing in the way of a third, with any improvements, he re-modelled the work, throwing it into a systematic form, revising the whole, supplying generic characters, with numerous additions of species, and various emendations and remarks. The uses and medicinal qualities of the plants are removed to the alphabetical index at the end. A second edition of this *Synopsis* was published in 1696, nor did its author ever prepare another. The third, now most in use, was edited twenty-eight years afterwards by DILLENIUS. (See that biographical article.) Of all the systematical and practical Floras of any country, the second edition of Ray's *Synopsis* is the most perfect that ever came under our observation. "He examined every plant recorded in his work, and even gathered most of them himself. He investigated their synonyms with consummate accuracy; and if the clearness and precision of other authors had equalled his, he would scarcely have committed an error. It is difficult to find him in a mistake or misconception respecting Nature herself, though he sometimes misapprehends the bad figures, or lame descriptions, he was obliged to consult." *Tr. of Linn. Soc. v. 4. 277.* Above a hundred species are added, in this second edition, and the cryptogamic plants, in particular, are more amply elucidated. A controversial letter from Rivinus to Ray, and its answer, with remarks upon Tournefort, are subjoined to this second edition. Much of the dispute turns upon the now obsolete distinction of plants, in a methodical system, into trees, shrubs, herbs, &c. The letters are well written, in Latin: and liberal, though perhaps hypercritical, in their style. Ray took no delight in controversy. Its inevitable

evitable asperities were foreign to his nature. We must not omit to notice that, in the preface to both editions of his *Synopsis*, the learned author, venerable for his character, his talents, and his profession, as well as by his noble adherence to principle in the most corrupt times, has taken occasion to congratulate his country, and to pour out his grateful effusions to Divine Providence, in a style worthy of Milton, for the establishment of religion, law, and liberty, by the revolution which placed king William on the throne. An honest Englishman, however retired in his habits and his pursuits, could not have withheld this tribute at such a time; nor was any loyalty ever more personally disinterested than that of Ray.

The year 1690 was the date of the first publication of his noble work on "The Wisdom of God in the Creation," of which we have already spoken, and whose sale, through many editions, was very extensive. In 1700 he printed a book, more exclusively within the sphere of his sacred profession, called "A Persuasive to an Holy Life;" a rare performance of the kind, at that day, as it would be at the present; being devoid of enthusiasm, mysticism, or cant, as well as of religious bigotry or party spirit, "and employing the plain and solid arguments of reason, for the best of purposes." His three "Physico-Theological Discourses, concerning the Chaos, Deluge, and Dissolution of the World," of which the original materials had been collected and prepared formerly at Cambridge, came out in 1692, and were reprinted the following year. A third edition, superintended by Derham, was published in 1713. This able editor took up the same subject himself in a similar performance, the materials of which, like Ray's, were first delivered in sermons, at Bow church, he having been appointed reader of Mr. Boyle's lectures.

While Ray was from time to time intent on these moral and religious performances, in which he laboured equally to impress and elucidate the truths of natural and revealed religion, as well as to enforce its precepts and duties, he was no less attentive than formerly to his systematical studies. Dr. Tanager Robinson is recorded by Derham, as having first prompted our great naturalist to undertake a *Synopsis Methodica*, or classical arrangement, of the whole animal, as he had done of the vegetable, kingdom. He even wished him to extend his attention to fossils, anticipating, in short, what Linnæus afterwards performed. Nor did he shrink from the task. Though now for some time oppressed with bodily infirmity, and particularly with very troublesome ulcers in his legs, his mind was tranquil and unimpaired. He soon finished his *Synopsis Methodica Animalium Quadrupedum et Serpentinæ Generis*, which came out in 1693, making a thin, but closely printed, octavo volume. We have already spoken of the originality of his method. The volume in question, however, is not confined to dry systematical arrangement. It enters deeply into the general and particular history of animals, their external forms, and internal structure, with abundance of entertaining and curious facts and observations. Linnæus was possessed of this book from the year 1734, and appears to have studied it well. A similar volume on birds, and another on fishes, were prepared by the author; but the manuscripts of these lay neglected in the hands of some careless or ignorant bookseller, till they were discovered by Dr. Derham, and published in 1713. They contain more of particular descriptions and histories, than of general remarks; but otherwise accord with the plan of the *Synopsis* of Quadrupeds. Many things are supplied from materials obtained since the publication of Willughby's Ornithology and Ichthyology, and several figures of fishes were added by Derham, at the

persuasion of Petiver, whose works they somewhat resemble.

Having accomplished so many great and laborious publications, our venerable naturalist began, as Dr. Derham informs us, to enjoy the thoughts of repose from his labours. He was nevertheless ready, at the call of his friends, to revise a translation of Rauwolf's Travels, the original having even then become very scarce, besides being unintelligible to mere English readers. This translation, with some other rare tracts annexed, and a catalogue of Grecian, Syrian, Egyptian, and Cretan plants, drawn up by Mr. Ray, issued from the press in 1693. See RAUWOLFIA.

Possibly the *Stirpium Europæarum extra Britannias nascentium Sylloge*, which appeared in 1694, originated in the author's attention being recalled, by the last-mentioned publication, to the contemplation of exotic plants. In this volume he collects from Clusius, Bauhin, Columna, and others, various additions to his own discoveries, and the whole are disposed in alphabetical order. A geographical view of the plants, which he had himself gathered in his foreign travels, is subjoined; and the volume concludes with alphabetical catalogues, selected from Boeckon's Sicilian plants, and other recent authors. It is in the preface to this book, that he first adverts to the system of Rivinus, not without just applause of that author's work, a copy of which had been presented to Ray. He commends the apt distribution of the genera, the clearness and conciseness of the style, the purity of the Latin, and the beauty as well as exactness of the plates. He, however, contends for the ancient distinction of plants into trees and herbs, which, as we have seen, he had himself mentioned as unphilosophical. In the rest of his criticisms, though "much may be said on both sides," and though these controversialists, like others, profit of the intricacies and anomalies of Nature, to make good their arguments, concealing themselves, like the cuttle-fish, in their ink; still we cannot but give our testimony to the greater solidity of Ray's principles, as derived from the fruits and seeds of plants, than to the seemingly more elegant ones of Rivinus, deduced from the flower; which last undoubtedly lead, in their practical application, to some paradoxical combinations. But on this subject we may say more in its proper place. (See RIVINUS.) In this preface Ray points out the importance and use of the stamens and pistils, succinctly explaining the sexual doctrine, as now universally admitted.

One advantage arose from the epistolary altercation of Rivinus and Ray, that it led the latter to revise his own system, and to republish it, in an improved state. Happy if such were more generally the fruit of contention, that each party should correct himself, instead of aggravating the defects of his adversary. Some notice is taken, in the preface to this edition, both of the system of Tournefort and that of Hermann, which last was most congenial to the principles of Ray. The work was finished in 1698, but not given to the public till 1703, recourse having been had to a Dutch bookseller, who thought it for his interest to place an English publisher's name in the title-page; a proceeding which, however harmless, shocked the honest feelings of the author; and this perhaps excited the thrifty Hollander's surprise. By his exertions, however, the book, and the fame of its author, became more widely diffused, and continental botanists were much further initiated into Ray's system than they had previously been.

But now the mortal career of this eminent man was drawing towards a close. He complained in his letters, that, so far from being able to visit the London gardens, as he wished,

in order to make observations upon plants, for the greater perfection of this last edition of his *Methodus*, he was not able to walk into his neighbouring fields. He still, nevertheless, kept up to the last his correspondence with his friends, in the vivacity and clearness of style which was natural to him. Latin and English, it is said, were equally ready to his pen. So indefatigable was he in the cultivation of the study of Nature, that within a year or two of his death, he began to collect his scattered notes for a work on Insects, and actually drew up a *Methodus Insectorum*, which was printed, soon after his decease, in a little octavo of sixteen pages, and republished in the front of his *Historia Insectorum*. This last book, comprising all his own and Mr. Willughby's descriptions of insects, came from the press in 1710, at the expence of the Royal Society, and under the superintendence of Dr. Derham. It consists of 375 quarto pages, besides an appendix of twenty-three more, on British Beetles, by Lister. Ray attributes to Willughby that part of his system which concerns insects supposed to undergo no metamorphosis. These are mostly the *aptera* of Linnæus, excluding the *crustacea*, but admitting insectal *vermes*, earth-worms, and even leeches. All the descriptions and remarks of his departed friend are marked with the initials F.W. This work is a mass of accurate and authentic observation; but, for want of plates, has never come into popular use. Linnæus studied it much, and has often cited the descriptions, the appropriation of which is, however, too difficult and uncertain to render them of general or extensive service. Those which regard the *Lepidoptera*, and their caterpillars, are most copious.

The study of insects was probably the last that engaged the attention of this great and wise man; who, though on the verge of eternity, in the full possession of himself, and in the anticipation of the most glorious manifestations of his Creator, did not disdain or neglect to contemplate him in his least and lowest works. Such an example might serve for an occasional answer to those who affect to think the study of any of the works of God below the dignity of their philosophy; for the most inordinate vanity must look with respect on what formed the abstruse studies of so distinguished a person as Ray. His last letter to Dr. Derham, who had just been to visit him, is dated August 16, 1704. He speaks of having lately obtained Mr. Willughby's entomological papers, and describes himself as then entering on his History of Insects. How well he employed his time during the autumn, is evident from what we have related concerning this work, for he never saw another spring. He died at Black Notley, in a house of his own building, Jan. 17, 1705, in the 77th year of his age. His character is thus concisely given by Derham. "In his dealings, no man more strictly just; in his conversation, no man more humble, courteous, and affable; towards God, no man more devout; and towards the poor and distressed, no man more compassionate and charitable, according to his abilities." The friend who wrote this eulogium, in his "Life of Mr. Ray," asserts, that he was buried, according to his own desire, in the church of Black Notley; but the authors of the Biographia Britannica are probably more correct, in saying, that he declined the offer made him by the rector, of a place of interment in the chancel, choosing rather to repose with his ancestors, in the church-yard. He perhaps thought, with bishop Hall, that "the house of God ought not to be made a repository for dead carcases." However this might be, the latter account is confirmed by the original situation of his monument, erected at the expence, in part at least, of bishop Compton. The long and elegant Latin epitaph has often been published. Its author was the Rev.

William Coyte, M.A., father of the late Dr. Coyte of Ipswich, and the original manuscript is now before us, containing the information that Ray was interred in the church-yard. In 1737, the monument in question, which seems to have been a sort of altar tomb, being nearly ruined, was restored at the charge of Dr. Legge, and removed for shelter into the church; where therefore it became a *cenotaph*, as an inscription added on this occasion terms it. Forty-five years afterwards the tomb again underwent a repair, by the care of the present sir Thomas Gery Cullum and others, who subjoined a third inscription, as follows:

Tumulum hunc,
a nonnullis humanitati, et scientiæ
naturali, faventibus,
olim conditum,
et aliorum bonâ diligentia
postea restauratum, 1737,
nunc e vetustatis situ et fordibus
pauci de novo revocarunt, 1792.
ἀνδρῶν ἐτιζάντων πρὸς αὐτῶν τὰς ἀρετὰς.

A more lasting monument was dedicated to the memory of our great English naturalist, in the genus of plants which bears his name. (See *RAIANIA*.) The opinion we have there, in few words expressed, of his high rank in botanical science, it is hoped the present more diffuse account will justify. It must be lamented that he made, as far as we can learn, no collection of dried plants, which might serve to ascertain, in every case, what he described. The great Herbariums of Buddle, Uvedale, &c. still kept in the British Museum, are indeed supposed to supply, in a great measure, this defect; they having been collected by persons who had frequent communication with Ray, and were well acquainted with his plants. Whatever he had preserved relative to any branch of natural history, he gave, a week before his death, to his neighbour Mr. Samuel Dale, author of the *Pharmacologia*. Nothing is said of his library, which was probably inconsiderable. His pecuniary circumstances were very limited, for he merely conformed as a layman to the church of England, and was unwilling to subscribe what was requisite for receiving preferment. He is recorded nevertheless to have disapproved of separatists from the national church; justly disgusted, probably, by the contentions and fanaticism he had seen throughout the greater part of his life. His principles and feelings soared far above the fastidious distinctions, which marked the orthodox or the heterodox of those times, and his mind was uncontaminated with their passions. His good sense might well lead him to regret, that those who had so lately escaped a most tremendous common enemy, should be so prone to quarrel amongst themselves. It is an honour to both these parties that they have been emulous to claim him as their ally.

In the preceding review of the literary productions of Ray, more numerous, as Haller says, than those of any other botanist, Linnæus excepted, we have been obliged to pass over several things of less note; such as his lists of native British plants, for Gibson's edition of Camden's *Britannia*; and even a variety of communications to the Royal Society. Neither have we touched on the principles of his botanical system, that subject being explained at length by our predecessor, the late Rev. Mr. Wood, under the article *CLASSIFICATION*. Those who are anxious to peruse a more full and critical investigation of his works and studies, than it has been possible to give in this place, will do well to consult Dr. Pulteney's "Sketches of the Progress of Botany in England." The "Philosophical Letters," collected and published in 1718, by Dr. Derham, containing 68 written by Ray, and

many more by his correspondents, throw much light on his character and pursuits. We cannot help remarking that his hand-writing was peculiarly fair and elegant. A specimen of it exists among Sir Henry Spelman's vast and curious collection of manuscripts, now in the possession of John Patterson, esq. late M. P. for Norwich.

The portraits of Ray are not numerous. One in oil, taken at an advanced period of his life, remains in the British Museum, and Dr. John Sims is possessed of a miniature, of an earlier date, of which its owner has given an engraving, by way of frontispiece to the first volume of the "Annals of Botany," published in 1805. The latter is rather deficient in that strength of character which appears in the more common prints, after a picture by Faithorne, often prefixed to the third edition of the *Synopsis*, and sometimes to the *Historia Plantarum*. One of these prints was engraved by Elder; the other by Vertue. Neither of them is strictly appropriated to any particular book. That in the German edition of his "Wisdom of God in the Creation," published at Leipzig in 1732, appears to be copied from one of these, and yet is so unlike them in expression, that if it were possible, one would suppose it taken from some other portrait of the same person. Ray's Works. His Life by Dr. Derham. Haller's Bibl. Bot. Pulteney's Sketches. Aikin's General Biography. S.

RAY, in *Geography*, a town of France, in the department of the Upper Saone; 12 miles E. of Champlitte.

RAY, in *Geometry*. See RADIUS.

RAY, *Radius*, in *Optics*, a beam or line of light, propagated from a radiant point, through any medium.

Sir Isaac Newton defines rays to be the least parts of light, whether successive in the same line, or contemporary in several lines.

For, that light consists of parts of both kinds, appears hence, that one may stop what comes this moment in any point, and let pass that which comes the next; and again, one may stop what comes in this point, and let pass that in the next. Now, the least light, or part of light, which may be thus stopped alone, he calls a *ray of light*.

A ray of light is, therefore, considered as an infinitely narrow portion, or an evanescent element of a stream of light; and a pencil, as a small detached stream, composed of a collection of such rays accompanying each other. As we cannot exhibit to the senses a single mathematical line, except as the boundary of two surfaces; in the same manner, we cannot exhibit a single ray of light, except as the confine between light and darkness, or as the lateral limit of a pencil of light.

If the parts of a ray of light do all lie straight between the radiant and the eye, which is the case when it moves through the same uniform substance or a vacuum, called a medium, the ray is said to be *direct*: the laws and properties of which make the subject of optics. If any of them be turned out of that direction, or bent in their passage, the ray is said to be *refracted*: and that branch of optics which treats of these refracted rays, is called *dioptrics*; which see. See also REFRACTION.

If it strike on the surface, or medium attached to the surface, of any body, and be driven back, it is said to be *reflected*: and that branch of optics which treats of these refracted rays, is called *catoptrics*; which see. See also REFLECTION.

In each case, the ray, as it falls either directly on the eye, or on the point of reflection, or of refraction, is said to be *incident*: and the angle which the incident ray makes with the perpendicular to the reflecting surface at the point of incidence, is called the angle of incidence; and the angle

which the reflected ray makes with the same perpendicular, is called the angle of reflection; and also, the angle which the refracted ray makes with a perpendicular to the refracting surface produced, is called the angle of refraction.

Again, if several rays be propagated from the radiant equidistantly from one another, they are called *parallel rays*. If they come inclining towards each other, they are called *converging rays*. And if they go continually receding from each other, they are called *diverging rays*.

It is evident that the rays of light, which come from a luminous point, must fall divergingly upon any given surface; yet when the object is very distant, compared with the interval that separates these rays, the divergency of the rays becomes insensible; hence the rays of the sun, of the moon, of the stars, &c. are deemed parallel rays. When the luminous point is near, then the rays are sensibly diverging.

It is from the various circumstances of rays, that the several kinds of bodies are distinguished in optics. A body, *e. gr.* that diffuses its own light, or emits rays of its own, is called a *lucid*, or *luminous* body. If it only reflect rays which it receives from another, it is called an *illuminated* body.

This distinction, however, is not always observed; for a luminous body, in common language, means any visible object, whether it be visible by the emission of original light, like the sun, a candle, &c. or by reflected light, like the moon, or any other celestial or terrestrial object that has no native light, or that does not emit its own light.

If an object only transmit rays, it is called a *transparent* body. So that transparent bodies, such as water, glass, &c. are those through which light will pass, or through which our eyes can perceive objects situated on the other side, and all such bodies, as also a vacuum, are denominated mediums in optics.

If it intercept the rays, or refuse them passage, so that nothing can be seen through it, it is called an *opaque* body.

Hence no body radiates, *i. e.* emits rays, unless it be either luminous, or illumined.

It is by means of rays reflected from the several points of illumined objects to the eye, that they become visible, and that vision is performed; whence such rays are called *visual rays*.

When an eye views any object directly, some of the rays, which proceed from every perceivable point of the object, enter the eye, and the whole number of rays, or quantity of light, which thus enters the eye, is circumscribed by the rays which proceed from the extreme points of the object: and the angle which these extreme rays form at the eye is called the *visual angle*, from the magnitude of which we principally judge of the distance of a known object. Thus, if the same object is represented at different distances, it is evident that the farther the object is from the eye, the smaller will the visual angle be. Supposing also the distance between the eye and the object to remain the same, if by any means the rays of light are bent so as to enlarge the visual angle, then the object will appear larger, or it is said to be magnified; and on the contrary, if the visual angle be diminished, then the object will appear smaller, in which case it is said to be diminished.

In effect, we find that any point of an object is seen in all places to which a right line may be drawn from that point: but it is allowed, nothing can be seen without light; therefore every point of an object diffuses innumerable rays every way. Again, from other experiments it appears, that the images of all objects, whence right lines may be drawn to

the eye, are painted in the eye, behind the crystalline, very small, but very distinct.

And lastly, from other experiments, that each ray produces an image of the radiating point: and that the several rays emitted from the same point are again united in one point, by the crystalline, and other humours of the eye, and thus thrown on the retina.

It is the spissitude or closeness of the rays emitted from a luminous body, that constitutes the intenseness of the light. Yet the direction in which the rays strike the eye, has a considerable influence. In effect, a perpendicular ray, striking with more force than an oblique one, in the ratio of the whole sine to the sine of the angle of obliquity (as follows from the laws of *percussion*, which see,) a perpendicular ray will affect the eye more vividly than an oblique one, in that ratio.

If then the spissitude of the rays be equal, the intensity will be as the direction: if the direction be the same, the intenseness will be as the spissitude: if both differ, the intenseness will be in a ratio compounded of the direction and the spissitude.

Hence, first, if light be propagated in parallel rays through an unresisting medium, its intensity will not be varied by distance.

Secondly, if light be propagated in diverging rays through an unresisting medium; its intensity will decrease in a duplicate ratio of the distances from the radiant point, reciprocally.

Thirdly, if light be propagated in converging rays through an unresisting medium; its intensity will increase in a duplicate ratio of the distances from the point of concurrence, reciprocally.

Fourthly, if the breadth of an illumined plane be to the distance of the radiant point as 1 to 2,000,000, it is the same thing as if the ray struck upon it parallel: and hence, since the diameter of the pupil of the eye, when largest, scarcely exceeds $\frac{1}{4}$ th or $\frac{1}{5}$ th of an inch; the rays will fall upon it parallel as to sense, at the distance of 3860 English feet, which is nearly six furlongs. See LIGHT.

The effect of concave lenses, and convex mirrors, is to make parallel rays diverge; converging rays become parallel; and diverging rays to become more divergent.

The effect of convex lenses, and concave mirrors, is to make diverging rays become parallel; parallel rays become convergent; and converging rays to converge the more. See LENS.

The rays of light are not homogeneous, or similar, but differ in all the properties with which we are acquainted; viz. refrangibility, reflexivity, and colour.

It is probable that from the different refrangibility the other differences have their rise; at least it appears, that those rays which agree or differ in this, do so in all the rest. Thus, from the different sensations the differently disposed rays excite in us, we call them *red* rays, *yellow* rays, &c.

The effect of the prism is to separate and sort the different kinds of rays, which come blended promiscuously from the sun; and to throw each kind by itself, according to its degree of refrangibility and colour, red to red, blue to blue, &c.

Besides refrangibility, and the other properties of the rays of light already ascertained by observation and experiment, sir Isaac Newton suspects they may have many more; particularly, a power of being inflected, or bent, by the action of distant bodies; and those rays which differ in refrangibility, he conceives likewise to differ in this flexibility.

In passing by the edges and sides of bodies, he conceives that the rays may be bent several times backwards and forwards, with a motion like that of an eel; and that those rays which appear to fall on bodies are reflected or refracted before they arrive at the bodies: and adds, that they may be refracted, reflected, and inflected, all by the same principle acting in different circumstances. See INFLECTION and LIGHT. See also REFLECTION and REFRACTION.

Again, do not the rays, falling on the bottom of the eye, excite vibrations in the retina; which, being propagated along the fibres of the optic nerve into the brain, cause vision? and do not several sorts of rays make vibrations of several bignesses, which excite sensations of several colours, much after the manner as the vibrations of the air, according to their several bignesses, excite sensations of several sounds?

Particularly, do not the most refrangible rays excite the shortest vibrations, to make a sensation of a deep violet; and the least refrangible the largest, to make a sensation of a deep red? and the several intermediate kinds of rays, vibrations of intermediate bignesses, to make sensations of the intermediate colours?

And may not the harmony and discord of colours arise from the proportion of these vibrations; as those of sound depend on the vibrations of the air; for some colours, if viewed together, are agreeable, as gold and indigo; others disagreeable. See COLOUR.

Again, have not the rays of light several sides endued with several original properties? It is certain we find, that every ray of light has two opposite sides, originally endued with a property, on which the unusual refraction of island crystal depends, and other two opposite sides endued with that property.

Lastly, are not the rays of light very small bodies emitted from shining substances?

Such bodies may have all the conditions of light: and there is that action and re-action between transparent bodies and light, which very much resembles the attractive force between other bodies. Nothing more is required for the production of all the various colours, and all the degrees of refrangibility, but that the rays of light be bodies of different sizes; the least of which may make violet the weakest and darkest of the colours, and be the most easily diverted by refracting surfaces from its rectilinear course; and the rest as they are bigger and bigger, may make the stronger and more lucid colours, blue, green, yellow, and red. (See COLOUR and LIGHT.) Nor is any thing more requisite for the putting of the rays into fits of easy reflection, and easy transmission, than that they may be small bodies, which, by attraction, or some other force, excite vibrations in the bodies they act upon; which vibrations, being swifter than the rays, overtake them successively, and agitate them so as by degrees to increase and diminish their velocity, and thereby put them into those fits. Lastly, the unusual refraction of island crystal appears very much as if it were performed by some attractive virtue lodged in certain sides both of the rays, and of the crystal.

RAYS of Heat denote separate portions of that emanation, which proceeds from an heated body, when placed in a colder temperature, and which expands itself in every direction, provided it be not prevented by the interposition of particular substances. This appellation is adopted and thus applied, not because that emanation is certainly known to consist of separate streams, but merely for the convenience of explanation. The rays of heat are not the same with the rays of light. If this were the case, a certain quantity of

of heat ought to be accompanied with the same quantity of light; whereas it is found, that several substances emit a considerable quantity of light without any sensible heat, and others give out a considerable portion of heat without any light. But that these are two distinct powers of nature is a proposition, that has been amply illustrated, and most satisfactorily established by the discoveries and experiments of Dr. Herschel. This celebrated astronomer cautions those, who peruse the account of his experiments and observations upon them, from concluding, that in using the word rays, he means to oppose, much less to countenance, the opinion of those philosophers, who still believe, that light itself comes to us from the sun, not by rays, but by the supposed vibration of an elastic ether, every where diffused through space: he merely claims the same privilege for the rays that occur in heat, which they do not scruple to allow to those that illuminate objects. For in what manner soever this radiance may be effected, he undertakes to prove, that the evidence, either for rays, or for vibrations, which occasion heat, stands on the same foundation on which the radiance of the illuminating principle, light, is built.

Proposing to give a comparative view of the operations that may be performed on the rays that occasion heat, and of those which are known to have been effected on the rays that occasion light, he selects such facts as are well known with regard to the latter. Light, he says, both solar and terrestrial, is a sensation occasioned by rays emanating from luminous bodies, which have a power of illuminating objects; and, according to circumstances, of making them to appear of various colours. The rays of light are subject to the laws both of reflection and of refraction; but they are of different refrangibility. They are liable to be stopped in certain proportions, when transmitted through diaphanous bodies; and also to be scattered on rough surfaces. They are also supposed to have a power of heating bodies; but this is a subject "sub judice." The similar propositions, which it is his design to prove, and which by a variety of curious and well-conducted experiments he has confirmed, are such as follow. Heat, both solar and terrestrial, is a sensation occasioned by rays emanating from candent substances, which have a power of heating bodies. These rays are subject to the laws of reflection and of refraction; and they are of different refrangibility. They are liable to be stopped, in certain proportions, when transmitted through diaphanous bodies; and to be scattered on rough surfaces: and in a certain state of energy, they may be supposed to have a power of illuminating objects, which latter property remains to be examined.

In the examination of the illuminating and heating power of the prismatic colours, our author observes, that the red-making rays are very far from having the former in an eminent degree: the orange possesses more of it than the red; and the yellow rays illuminate objects still more perfectly. The maximum of illumination lies in the brightest yellow, or palest green. The green itself is nearly equally bright with the yellow; but from the full deep green, the illuminating power decreases very sensibly; that of the blue is nearly upon a par with that of the red; the indigo has much less than the blue; and the violet is very deficient. Our author infers from other experiments, that the heating power of the prismatic colours is very far from being equally distributed; and that the red rays are chiefly eminent in this respect. Allowing that the power of heating is chiefly lodged in the red-making rays, it accounts for the comfortable warmth that is thrown out from a fire, when it is

in the state of a red glow, and for the heat which is given by charcoal, coke, and balls of small coal mixed up with clay, used in hot-houses; all which throw out red light. It also explains the reason, why the yellow, green, blue, and purple flames of burning spirits mixed with salt, occasion so little heat that a hand is not materially injured, when passed through their combustions.

Having ascertained, that radiant heat is subject not only to the laws of refraction, but to those also of the different refrangibility of light, Dr. Herschel is led to surmise, that this heat consists of particles of light of a certain range of momenta, which range may extend a little farther, on each side of refrangibility, than that of light. In a gradual exposure of the thermometer to the rays of the prismatic spectrum, beginning from the violet, he found that he arrived at the maximum of light long before he came to that of heat, which lies at the other extreme. By several experiments it appears, that the maximum of illumination has little more than half the heat of the full red rays; and from other experiments our author concludes, that the full red falls still short of the maximum of heat, which perhaps lies even a little beyond visible refraction. In this case, radiant heat will at least partly, if not chiefly, consist, if the expression may be allowed, of invisible light, that is, of rays coming from the sun, that have such a momentum as to be unfit for vision. Admitting it as highly probable, that the organs of sight are only adapted to receive impressions from particles of a certain momentum, this will explain why the maximum of illumination should be in the middle of the refrangible rays, as those which have greater or less momenta, are likely to become equally unfit for impressions of sight. Whereas, in radiant heat, there may be no such limitation to the momentum of its particles. From the powerful effects of a burning lens, however, we derive information, that the momentum of terrestrial radiant heat is not likely to exceed that of the sun; and that, consequently, the refrangibility of *calorific* rays cannot extend much beyond that of *colourific* light. Hence we may also infer, that the invisible heat of red-hot iron, gradually cooled till it ceases to shine, has the momentum of the invisible rays, which, in the solar spectrum viewed by daylight, go to the confines of red, and this will afford an easy solution of the reflection of invisible heat by concave mirrors.

Our author deduces from various experiments with the thermometer abundant evidence, that there are rays coming from the sun, which are less refrangible than any of those that affect the sight. They are invested with a high power of heating bodies, but with none of illuminating objects; and on this account they have hitherto escaped notice. At the distance of fifty-two inches from the prism, there was still a considerable heating power exerted by the invisible rays, an inch and a half beyond the red ones, measured upon their projection on a horizontal plane. Moreover, the power of heating is extended to the utmost limits of the visible violet rays, but not beyond them; and it is gradually impaired, as the rays become more refrangible. The maximum of the heating power is found to be vested among the invisible rays, and it is probably not less than half an inch beyond the last visible ones. It is also shewn, that the sun's invisible rays, in their less refrangible state, and considerably beyond the maximum, still exert a heating power fully equal to that of red-coloured light; and consequently, if we may infer the quantity of the efficient from the effect produced, the invisible rays of the sun probably far exceed the visible ones in number. The general conclusion with which Dr. Herschel closes his account of one series

of experiments and his reasoning upon them, is in the following manner: "if," says he, "we call *light* those rays which illuminate objects, and *radiant heat*, those which heat bodies, it may be inquired whether light be essentially different from radiant heat? In answer to which I would suggest, that we are not allowed by the rules of philosophy to admit two different causes to explain certain effects, if they may be accounted for by one. A beam of radiant heat emanating from the sun, consists of rays that are differently refrangible. The range of their extent, when dispersed by a prism, begins at violet-coloured light, where they are most refracted, and have the least efficacy. We have traced these calorific rays throughout the whole extent of the prismatic spectrum, and found their power increasing, while their refrangibility was lessened, as far as to the confines of red-coloured light. But their diminishing refrangibility, and increasing power, did not stop here: for we have pursued them a considerable way beyond the *prismatic spectrum* into an invisible state, still exerting their increasing energy, with a decrease of refrangibility up to the maximum of their power; and have also traced them to that state, where, though still less refracted, their energy, on account, we may suppose, of their now failing density, decreased pretty fast; after which the invisible *thermometrical spectrum*, if I may so call it, soon vanished."—"If this," continues our author, "be a true account of solar heat, for the support of which I appeal to my experiments, it remains only for us to admit, that such of the rays of the sun as have the refrangibility of those which are contained in the prismatic spectrum, by the construction of the organs of sight, are admitted, under the appearance of light and colour; and that the rest, being stopped in the coats and humours of the eye, act upon them, as they are known to do upon all other parts of our body, by occasioning a sensation of heat."

Although, as we have above stated, the rays of light and those of heat possess many similar properties, yet Dr. Herschel has shewn, that there are some striking and substantial differences between them. The rays of heat are of a much more extensive refrangibility than those of light, as our author has clearly and incontestibly demonstrated both by reasoning and experiment: nor do those rays agree either in their mean refrangibility, nor in the situation of their maxima. Where we have most light, there is but little heat, and where we have most heat, we find no light at all. (See REFRACTION.) It is found, that the sines of refraction of the heat-making rays are in a constant ratio to the sines of incidence; but that the focus of the rays of heat in burning glasses is different from the focus of the rays of light: that of heat being farther removed from the lens than the focus of light, probably not less than a quarter of an inch: the heat at half an inch beyond the focus of light being still equal to that in the focus. Although light and heat are both refrangible, the ratio of the sines of incidence and refraction of the mean rays is not the same in both. Heat is evidently less refrangible than light. From experiments relating to the transmission of light and heat through diaphanous bodies it appears, that no kind of regularity takes place in the proportion of rays of one sort and of another, which are stopped in their passage. Heat and light seem to be entirely unconnected, and the rays that occasion them are different. We have several tables, formed from the author's experiments, and shewing the quantities of light and heat intercepted by different substances. The blueish-white and flint-glasses, *e. gr.* stop nearly three times as much heat as light, whereas the greenish crown glass stops only about one-fourth more of the former than of the latter.

From a table exhibiting the effects of coloured glasses, it appears, that a yellow glass stops only 333 rays of heat, but stops 819 of light; on the contrary, a pale blue stops 812 rays of heat, and but 684 of light. Again, a dark blue glass stops only 362 rays of heat, but intercepts 801 of light; and a dark red glass stops no more than 606 rays of heat, and yet intercepts nearly all the light, scarcely one ray out of 5000 being able to make its way through it. For the conclusions deduced from these tables, as they evince the non-identity of the rays of heat and those of light, and for the tables themselves, we must refer to the author's own paper, *ubi infra*. We are restrained by our limits from pursuing this curious subject, and from entering on a detail of Dr. Herschel's experiments, illustrating and confirming principles, the discovery of which must be allowed to be one of the greatest that has been made since the days of Newton, although the theories of some speculative philosophers might have led to it a few years earlier. Dr. Herschel was occupied in determining the properties of various kinds of coloured glass, which rendered them more or less fit for enabling the eye to view the sun through a telescope; and for this purpose it was necessary to inquire which of the rays would furnish the greatest quantity of light, without subjecting the eye to the inconvenience of unnecessary heat. He first observed that the heat became more and more considerable as the thermometer approached the extreme red rays in the prismatic spectrum; and pursuing the experiment, he found not only that the heat continued beyond the visible spectrum, but that it was even more intense where the thermometer was at a little distance without the limits of the spectrum, than in any point within it; as we have already stated. For Dr. Herschel's communications to the Royal Society on this subject, we refer to the 90th volume of the Philosophical Transactions for the year 1800, part ii. p. 255, &c. p. 284, &c. p. 293, &c. part iii. p. 437, &c.

Sir Henry Englefield has repeated Dr. Herschel's experiments with many precautions, and Mr. (sir H.) Davy was a witness of their perfect accuracy. The excess of heat beyond the spectrum was even considerable enough to be ascertained by the sense of warmth occasioned by shewing it on the hand.

It was first observed in Germany by Ritter, and soon afterwards in England by Dr. Wollaston, that the muriate of silver is blackened by invisible rays, which extend beyond the prismatic spectrum, on the violet side. It is therefore probable, that these black or invisible rays, the violet, blue, green, perhaps the yellow, and the red rays of light, and the rays of invisible heat, constitute seven different degrees of the same scale, distinguished from each other into this limited number, not by natural divisions, but by their effects on our senses; and we may also conclude that there is some similar relation between heated and luminous bodies of different kinds. See Young's Phil. Lect. vol. i. p. 639. See HEAT and REFRACTION.

M. Delaroche has found, that the rays of invisible heat traverse glass with difficulty at a temperature below that of boiling water; but that they traverse it with a facility, always increasing with the temperature, as it approaches the point when bodies become luminous, and from these experiments it would appear, that the modification, whatever it be, which must be impressed upon the invisible rays to render them more and more capable of passing through glass, makes them approach more and more to the state in which they must be when they penetrate our eyes, and occasion the sensation of vision. The same ingenious philosopher has likewise found, that the rays of heat which have passed through

through a plate of glass are proportionably more adapted to pass through a second plate; and from this circumstance we deduce a new proof of the peculiar state of these rays, and of the modification which they acquire. Mellis. Gay-Lussac and Thenard have proved that all the changes of colour produced by light may be imitated and produced by heat, and by an elevation of temperature not exceeding 212° . Other phenomena previously observed indicated, that in the comparison of the actions of heat and light in heating bodies, or producing chemical changes in them, there is a great difference in the rays of different colours. M. Rochon announced the fact amply confirmed by Dr. Herschel, that the heat produced by the different rays of the prismatic spectrum was unequal. As Dr. Herschel fixed the maximum effect beyond the red rays, and shewed, as we have already stated, that the most heating rays of the spectrum were entirely, or nearly, invisible; Dr. Wollaston, and Messrs. Ritter and Beckmann, having examined the opposite, or violet end of the spectrum, found that this likewise possessed peculiar properties, and that, beyond the violet, there are invisible rays, which possess, in greatest perfection, the power of determining chemical combinations. It has been a subject of interesting research, whether the invisible, or almost invisible rays, situated beyond the extremities of the spectrum, possess any other properties of light. *E. gr.* If the reflection of them from polished glass can give them that modification which Malus has distinguished by the name of "polarization." (See LIGHT.) M. Berthollet engaged Messrs. Malus and Berard to undertake this double object. M. Malus's death prevented his prosecution of the subject; but what he began M. Berard accomplished with the utmost possible exactness. By means of the heliostat, which Malus caused to be constructed for the philosophical cabinet of M. Berthollet, he obtained a ray of light, perfectly fixed, on which he could make experiments at pleasure. By decomposing this ray with a prism, he obtained an immoveable coloured spectrum; and by placing very sensible thermometers in the spaces occupied by the different colours, he was enabled to compare their calorific effects with the utmost certainty. He also ascertained their chemical properties by substituting, in place of the thermometers, chemical compounds easily altered. He first of all observed the calorific power of the different rays, which, it is known, are in this respect unequal. M. Rochon, who is said to have first observed this inequality, placed the maximum of heat in the yellow ray, where the illuminating power is the greatest. Dr. Herschel, as we have before shewn, placed it out of the spectrum, and beyond the red ray. The experiments of Herschel have been confirmed by those of Berard, as far as they respect the progressive heating power of the rays from the violet to the red; but he found the greatest heating power at the extremity of the spectrum itself, and not beyond it. He fixed it at the point, where the bulb of the thermometer was still entirely covered with the red ray; and he found that the thermometer sunk progressively, in proportion as the distance of its bulb from the red ray increased. When he placed the thermometer quite beyond the visible spectrum, on the spot where Herschel fixed the maximum of heat, its elevation above that of the ambient air was only one-fifth of what it had been in the red ray itself. The absolute intensity of the heat produced was likewise less in the experiments of Berard than in those of Herschel.

M. Berard wished to know if these properties would exist in each of the pencils into which the ray divides itself in passing through a rhomboid of Iceland spar. In this case each of the two spectra exhibited the same properties. In both, the calorific power diminished from the violet to the

red end; and it existed beyond the last visible red rays. In this operation the luminous molecules are polarized by the crystal. In order to determine whether the invisible rays of heat experience the same effect, M. Berard received the solar ray upon a polished and transparent glass, which polarized a portion of it by reflection. This reflected ray was then received upon a second glass, fixed in an apparatus, which permitted it to be turned round the ray under a constant incidence, and this incidence itself was determined in such a manner, that in a certain position of the glass the reflection ceased to take place. We know, from the experiments of Malus, that a glass may be always disposed in such a manner that this condition is fulfilled. Things being thus disposed, by collecting with a mirror the calorific and luminous rays reflected from the second glass, and directing them upon a thermometer, M. Berard found, that as long as light was reflected the thermometer was elevated, and of course the heat was reflected likewise; but when, from the position of the second glass, the light was totally transmitted, the heat was transmitted at the same time, and the thermometer was not elevated. In this experiment, then, as well as the preceding, the calorific principle, whatever it may be, never separates from the luminous molecules.

To the ray of solar light employed in this experiment, M. Berard substituted a pencil of radiant heat proceeding from a body hot, but not red, and even not luminous. The effect was the same as before. The thermometer rose when the second glass was so situated as to reflect light, and it did not rise when the second could not reflect light. Therefore the particles of invisible radiant heat are modified by reflection, precisely like light.

After having studied the calorific properties of the different rays of the spectrum, M. Berard examined their chemical properties. When muriate of silver, or other white salts of silver, are exposed to light, they become dark coloured very speedily. Guaiac thus exposed to light passes from yellow to green, as Dr. Wollaston observed. Gay-Lussac and Thenard discovered another action of this light still more prompt and energetic. When a mixture of oxymuriatic acid gas and hydrogen gas are exposed to the action of solar light, a detonation takes place, and water and muriatic acid are formed. These different phenomena enabled M. Berard to examine the chemical powers of the different rays of the spectrum. By exposing to the different coloured rays, pieces of card impregnated with muriate of silver, or small phials filled with the detonating mixture, he was enabled to judge of the energy of each by the intensity or rapidity of the chemical change which it produced. He found that the chemical intensity was greatest at the violet end of the spectrum, and that it extended, as Ritter and Wollaston had observed, a little beyond that extremity. When he left substances exposed for a certain time to the action of each ray, he observed sensible effects, though with an intensity continually decreasing in the indigo and blue rays. Hence we must consider it as extremely probable, that if he had been able to employ re-actives still more sensible, he would have observed analogous effects, but still more feeble, even in the other rays. To shew clearly the great disproportion which exists in this respect between the energies of the different rays, M. Berard concentrated, by means of a lens, all that part of the spectrum which extends from the green to the extreme violet; and he concentrated, by means of another lens, all that portion which extends from the green to the extremity of the red. This last pencil formed a white point so brilliant that the eyes were scarcely able to endure it; yet the muriate of silver remained more than two hours exposed to this brilliant light without undergoing any sensi-

ble alteration. On the other hand, when exposed to the other pencil, which was much less bright, and less hot, it was blackened in less than six minutes. M. Berard concluded, from this experiment, that the chemical effects produced by light are not solely owing to the heat developed in the body by its combining with the substance of the body; because, on such a supposition, the faculty of producing chemical combinations ought to be greatest in those rays which possess the faculty of heating in the greatest perfection: but perhaps we should find less opposition between these two opinions, if we attended to the different results which may be produced by the same agent placed in different circumstances, and if we considered that agents of a nature quite dissimilar may determine the same combinations when they are employed.

Various hypotheses have been suggested in order to account for the properties above stated. If we wish to consider solar light as composed of three distinct substances, one of which occasions light, another heat, and the third chemical combinations; it will follow that each of these substances is separable by the prism into an infinity of different modifications, like light itself; since we find, by experiment, that each of the three properties, chemical, colorific, and calorific, is spread, though unequally, over a certain extent of the spectrum. Hence we must suppose, on that hypothesis, that there exist three spectrums one above another; namely, a calorific, a colorific, and a chemical spectrum. We must, likewise, admit that each of the substances which compose the three spectrums, and even each molecule of unequal refrangibility which constitutes these substances, is endowed, like the molecules of visible light, with the property of being polarized by reflection, and of escaping from reflection in the same positions as the luminous molecules, &c.

Instead of this complication of ideas, let us conceive simply, according to the phenomena, that light is composed of a collection of rays unequally refrangible, and of course unequally attracted by bodies. This supposes original differences in their size and velocity, or in their affinities. Why should those rays, which differ already in so many things, produce upon thermometers, or upon our organs, the same sensations of heat or light? Why should they have the same energy to form or separate combinations? Would it not be quite natural that vision should not operate on our eyes, except within certain limits of refrangibility; and that too little or too much refrangibility should render it equally incapable of producing that effect. Perhaps these rays may be visible to other eyes than ours, perhaps they are so to certain animals, which would account for certain actions that appear to us marvellous. In a word, we may conceive the calorific and chemical faculty to vary through the whole length of the spectrum, at the same time with the refrangibility, but according to different functions; so that the calorific faculty is at its minimum at the violet end of the spectrum, and at its maximum at the red end; while, on the other hand, the chemical faculty expressed by another function is at its minimum at the red end, and at its maximum at the violet end, or a little beyond it. This simple supposition, which is only the simple statement of the phenomena, equally agrees with all the facts hitherto observed, and accounts for those established by M. Berard, and even enables us to predict them. In fact, if all the rays, which produce these three orders of phenomena, are rays of light, they must of course be polarized in passing through Iceland crystal, or in being reflected from a polished glass with a determined incidence: and when they have received these modifications, they must be reflected by another glass, if it is properly

placed, to exert its reflecting energy on the luminous molecules. On the other hand, if that force is null on the visible luminous molecules, the invisible light will not be any longer reflected: for the cause which occasions or prevents reflection appears to act equally upon all the molecules, whatever their refrangibility may be. It ought, therefore, to act upon the molecules of invisible light, the condition of visibility or invisibility relating merely to our eyes, and not to the nature of the molecules which produce these sensations in us.

This mode of viewing the facts appeared to Messrs. Berthollet, Chaptal, and Biot, who made a report to the Institute on the Memoire of Berard, the most natural and simple; though the modest reserve of Berard restrained him from deciding in a case, not sufficiently examined by the test of experiment. *Annal. de Chimie*, vol. lxxxv. p. 309. or *Thomson's Annals of Philosophy*, N° 9.

RAY, *Common*, in *Optics*, is sometimes used for a right line drawn from the point of concourse of the two optical axes, through the middle of the right line which passes through the middle of the centres of the pupils of the two eyes.

RAYs, *Cone of*. See CONE.

RAYs, *Deflection of*. See DEFLECTION.

RAYs, *Inclination of incident*. See INCLINATION.

RAYs, *Optic*. See OPTIC.

RAYs, *Reflexibility of*. See REFLEXIBILITY.

RAY, *Principal*, in *Perspective*, is the perpendicular distance between the eye and the vertical plane or table, as some call it. See PERSPECTIVE.

RAYs, *Pencil of*. See PENCIL of Rays.

RAYs, *Pyramid of*. See OPTIC Pyramid.

RAY of *Curvature*, in *Geometry*, is used to signify the semi-diameter of the circle of curvature. See RADIUS and CURVATURE.

RAY, *Raia*, in *Ichthyology*. See RAIA.

RAY, *Clavated*. See RAIA *Clavata*, and THORNBAC.

RAY, *Eagle*. See RAIA *Aquila*.

RAY, *Electric* or *Smooth*, a species of the raia. See RAIA, TORPEDO, and *Anatomy of Fish*.

RAY, *Fuller*, *Raia fullonica*, a species of ray, deriving its name from the instrument which fullers use in smoothing cloth, the back being rough and spiny. See RAIA *Fullonica*.

RAY, *Oblong*. See RAIA and RHINOBATOS.

RAY, *Oculated*. See RAIA and MIRALETUS.

RAY, *Rough*. See RAIA *Rubus*. At Scarborough, where it is common, it is called the white hans or gullet.

RAY, *Shagreen*, called at Scarborough the French ray, is about the size of the skate, but narrower in its form than the common kinds. The upper part of the body is covered closely with small shagreen-like tubercles, resembling the skin of the dog-fish; and from the nose to the beginning of the pectoral fins is a tuberculated space. Pennant.

RAY, *Sharp-nosed*. See RAIA *Oxyrinchus*. This fish makes a snorting noise, and is supposed to be the *bos* of the ancients, which Oppian describes as the broadest among fishes, and fond of human flesh; adding, that the method it takes of destroying men is by overlaying and keeping them down by its vast weight till they are drowned. Pennant.

RAY, *Sting*. See RAIA *Pastinaca*, and PASTINACA *Marina*.

RAY, in our *Old Writers*, a word appropriated to cloth never coloured, or dyed, 11 Hen. IV. c. 6. Blount, Cowel.

RAYs, in *Botany*, the spreading marginal florets of a compound flower; see RADIUS. The same term is applied to the sub-divisions of an umbel, more properly denominated its

its general and partial stalks; unless we, like Linnæus, consider the whole umbel as one aggregate flower. See *UMBELLA*, and *INFLORESCENCE*.

RAY-Grass, in *Agriculture*, an useful sort of early grass that has long been, and still is, much cultivated by the farmer in some districts. There are said to be different varieties of this grass, but that grown by Mr. Peacey, of Devonshire, has been found, on experience, much superior to the common sort. This grass has sometimes the title of rye-grass. See *LOLIUM Perenne*.

It has been remarked by the Rev. Mr. Duncan, of Kilmarnock, in the fourth volume of *Communications to the Board of Agriculture*, that it has been found of late that there is an annual and perennial kind; that the latter should only be sown; but that the annual seed, he thinks, affords the greatest and most palatable crop of hay, and may be sown on those light soils which more readily tend to grass, at least a considerable proportion of it should be blended with the perennial seed. He adds, that the two kinds of seeds are readily distinguished by a careful observer, as the perennial is smaller, and fairer in colour, than the annual, and likewise much lighter. Good annual seed weighs from 21 to 24 lbs. avoirdupois weight *per* bushel, but the perennial only from 16 to 18 lbs. As no distinction of these sorts was formerly made by farmers, he suggests it as probable that they have come to be known and distinguished, from the circumstance of no ray-grass disappearing wholly the first year, by which some persons have been tempted, from the high price of the seed, to allow what remained in the second year to advance to maturity, though to the great injury of the pasture. It is therefore from the seed of the second year's crop that he supposes the perennial grass has gradually originated; and its inferiority in point of substance seems, he thinks, to prove the supposition. By this means the farmer may, by allotting a small portion of good land for the purpose, supply himself with what is said to be the perennial seed, without submitting to the imposition of an extravagant price, and may probably ensure or improve upon the durability of it, by collecting seed from the third or fourth year's growth.

It is found to be an excellent grass for pasture as well as hay. It has an early, but not very abundant, foliage. It is highly relished by cattle and sheep. From its being apt to run up into flowering stems, it should be kept well fed down. From its secreting and depositing much saccharine matter in the joints of the stems, it affords a large proportion of nutritious matter for the support of animals, both in its green state and when made into hay. And it is said not to affect the wind of horses, which renders it particularly valuable for hunting and racing horses.

It has, however, been objected to by some, from the quantity of flower stems which it sends up; but this is asserted by others to be only the case when it grows in dry upland situations. It is found, of course, to vary much under different circumstances and situations.

The soils that are most suitable for it are those of the loamy and sandy kinds, but it is capable of being grown on those of the clayey sorts when not too stiff. On the two first sorts, in mixture with other grasses, it frequently becomes permanent, and affords an useful spring food, especially for sheep stock.

As it is found to produce a thick well-connected sward in soils of the rich fertile kinds, it has been supposed only suited to them, though occasionally met with in those of the poorer descriptions.

In Essex it is found very bad for the strong wet heavy lands.

But in other districts it is most sown in stiff clayey soils, where clover is liable to fail in coming up well. Some, however, find that a light soil is quite as suitable for it as one of a clayey nature; and that though it may be most sown in stiff heavy lands, it is not from the notion that lighter soils are less suited to it, but that such lands may be covered with this grass, should the clover crop not turn out well in consequence of the great stiffness of these clayey soils.

On the stiff clayey soils the proportion of seed is usually from one bushel to one bushel and a half of ray-grass, with eight or ten pounds of red clover seed, to the acre. On other soils from six to ten gallons of ray-grass, with from five to eight pounds of red clover seed, and from two to four pounds of trefoil seed, are used to the acre; some adding to these, two, three, or more, pounds of white clover seed.

In Sussex, for a layer for one or two years, they employ of ray-grass seed three gallons, and of red clover and trefoil seed each one gallon, to the acre.

But for permanent pasture the proportion is this. Of ray-grass seed four gallons, Dutch clover and trefoil seed, of each two gallons to the acre. Other different proportions are made use of in different cases.

It has been well remarked by Dr. Campbell, in the third volume of *Communications to the Board of Agriculture*, that when land is in a proper state of manure, ray-grass united with white clover, will form a perfect sward the latter end of the second year after it is sown. A particular field, of about five acres, that was sown with these two grasses only, was, he says, more perfectly grassed over, than others, which had the addition of trefoil and rib-grass, and which were sown at the same time. A neighbour of his, the only man in the county that had tried ray-grass, told him it would not answer, and referred him to a particular field where some had been sown. The fact was, the doctor says, that he had cropped his field with oats until it was no longer worth ploughing, and then, with his last seed, he sowed ray-grass, which certainly did not flourish. But his argument would, he thinks, have been equally conclusive against any grass or grain whatever. The ray-grass languished, and finally died away, giving place to the vegetation suited to the state of the land. If it be expected that ray-grass, or any other good grass, should thrive and produce abundant crops on exhausted or poor land, it must not, he says, be in the soil which occurs here. And he adds the following useful remarks, on converting ray-grass into hay; it is necessary to cut it at a period previous to its being so ripe as to have perfected its seed, and changed to a yellow colour; for in this case a great part of the juices of the plant, which constitute a principal part of the nutriment it is to afford, will be converted into a species of straw, and its nutritive properties be proportionably diminished. When it is made into hay, persons not acquainted with its qualities are apt to object to its apparent coarseness, which proceeds from its consisting almost entirely of flowering-stems, the ray-grass having a comparatively smaller proportion of leaves than any other grass. Whether this be a defect or a merit will, he thinks, depend upon a solution of this question: Do the stems and flowering parts of grass, or the leaves taken weight for weight, contain the greater proportion of nutriment? It does not appear, he says, that this has been determined by experiments instituted for the purpose; but it seems probable, from the stems being so much sweeter than the leaves, (which is particularly perceptible upon chewing them when about half dry,) and from those vegetables which contain much saccharine matter being particularly nutritious, that the greater proportionate quantity of

nutriment will be found to reside in the stalks; and if so, the advantages of ray-grafs will be decisive. But, however this may be, it is certain that, supposing wet weather comes on during the process of hay-making, the first part of the grafs that decays is the leaf, which soon becomes yellow, and then black, losing all pretensions to nutritive properties; in which case it is evident that almost the whole nutriment contained in the hay must reside, exclusively, in the flowering-stalks. Ray-grafs then has, in unfavourable hay-seasons, an advantage, he thinks, over all others, inasmuch as from having fewer leaves it is not so apt to be injured by a continuance of rain; and it is, besides, when in the cocks, more accessible to the air and wind from lying more open and light; and consequently not so apt to heat and mould as other grasses in similar situations and seasons. And he concludes that it certainly possesses the following valuable properties.

1. That there are few grasses so early in the spring.
2. That there are none better relished by cattle, or more nutritive.
3. That it has the power of resisting the effects of bad weather, in ticklish seasons, in a greater degree than other grasses.
4. That there is a greater facility in collecting its feed than of any other grafs.

It is supposed that the prejudices against it have proceeded, 1. From its having been sown in land not capable of producing a full crop of any good vegetable. 2. From allowing it to shoot up so far, as to have formed the seed in the flowering-stalk, before cattle have been turned into pasture, or that it has been cut for hay. Ray-grafs appears, he thinks, to partake more of the nature of grain than any other grafs. Hence, when it has perfected its seeds, it shoots out no more stalks, and but few leaves that season, as lord Kaimes has justly observed. Hence it is necessary to turn cattle into a field of this grafs early in the spring, and to keep it well under by a sufficient quantity of stock; in which case it will continue to put out fresh flowering-stalks and leaves during the whole season. 3. The hay, for the reason just assigned, should be cut before it becomes a mere straw. Common hay-grafs, being composed of grasses in various stages of growth and ripeness, admits of greater latitude than a field of ray-grafs, because many of them will generally be in a proper state for cutting, although others may have passed their prime.

He adds the following facts in support of its nutritious properties. No hay, says he, could be better relished by my horses than this was; not a particle of it was wasted by them, or left in the rack; no animals could thrive, coat, or do their work better, than they did, whilst they had this ray-grafs hay to take to. Never was there a greater contrast than when they were put to the natural hay-grafs of the country, after they had finished the other. They were literally starved into the eating of it; and in spite of an additional quantity of corn, they fell away (agreeable to his farming man's mode of expression) a limb a-piece. This year nothing can look better than his horses do upon this hay, (with which some red clover is mixed,) and this, with the addition of very little corn, and that mostly light, the tailings of oats and barley.

These facts place the utility of this grafs in a very striking point of view. And the following, given by Mr. Duncan, are of the same tendency, as he found in a comparative experiment of pieces of ground laid to pasture with it, and meadow soft-grafs alone and in mixture, that the ray-grafs portion was not only more early ready for the scythe by nearly three weeks, but the hay of it always more greedily eaten by the horses and cattle, as well as the pasture in succeeding years, on the ray-grafs division, constantly eaten

bare before the cattle flock would touch that of the soft grafs.

In the county of Essex the farmers in many places have, however, a very indifferent opinion of ray-grafs, believing it to do great injury to the land, especially when of the better kind. When sown with red clover, it does not do so well or is so good as a preparation for wheat, but it answers well for pease. In trying it mixed and unmixed with clover, some have found that when without it, it is all the better for the wheat; and that the wire-worm after ray is sure to destroy the wheat.

In weaning calves it is found extremely useful and advantageous, as it agrees very well with them, far better than tares, which are liable to run through them, or scour.

In Suffex this sort of grafs is employed in mixture with others, as a sheep-feed, with great benefit and success.

The farmers in the tillage parts of Oxfordshire also consider ray-grafs as preparing badly for wheat; they conceive that the wheat which follows will never be found so good where it is sown as where there is none. It is thought far from having any ameliorating effects on the land, as it *draws* too much. It is never sown alone by some. It makes the very worst hay, unless cut at an early period, or very young, in the opinion of many.

In Berkshire this grafs is sown in the chalk district, and found to a certainty less nutritious than many other sorts, as well as more exhausting in its nature. When intended for permanent pasture, it is found, in general, to fail in a very few years; and, unless the seed is changed, it will degenerate under any mode of management. It, however, possesses the advantage of being cheap, and of producing early feed, which are objects of no inconsiderable importance on a farm. Some find that the Peacey variety furnishes feed a fortnight or three weeks sooner than the common sort. It is seldom sown singly, but in mixture with many other artificial grasses, in proportions to suit the difference of soil. In some places it is sown with different other artificial grasses in variety, every four years, on different parts of the land, so as to prevent it getting sick of the same kind of feeds.

In the intention of hay, it should be cut early, or its juices will be much exhausted. Horses fed on this sort of hay are found to preserve their wind better than on hay of other grasses.

In Cheshire the dairy farmers do not consider it a good grafs for producing milk, on which account it is not so much cultivated; its earliness, however, has made it esteemed by many; as on almost any soil, some suppose it will be a pasture a week or ten days sooner than any other kind. And its having the property of correcting the tendency of clover to produce flatulency, renders it also highly worthy of the farmer's attention.

When for hay, if not cut early, the produce is scarcely so nutritious as straw.

This grafs-feed is sometimes sown alone, and the quantity of feeds which the plants afford, and the facility of collecting it, are probably the reasons of its being very common; while the advantages of its earliness have led to its more frequent cultivation. It is suggested, however, that several grasses, as the vernal, the fox-tail, the meadow poa, and some others, are equally as early as this grafs, and that the meadow fescue, the oat-grafs, and some others, seem to be as well deserving of the attention of the farmer.

According to the ingenious experiments on this grafs, made under the direction of the duke of Bedford, as stated in the appendix to sir Humphry Davy's Agricultural Chemistry, the results were as follow.

The quantity of produce from a rich brown loam, taken at the time of the plant's flowering, was	7827	3	0
Weight when dry	3322	4	13
Weight of produce lost by drying	4494	14	3
Quantity of nutritive matter	305	11	15
The quantity of produce taken at the time when the seed was ripe	14973	12	0
Weight when dry	4492	2	0
Weight of produce lost in drying	10481	10	0
Quantity of nutritive matter	643	6	7
Loss of weight in nutritive matter by taking the crop at the time of flowering, nearly half its value	337	8	8

Proportional value of the flowering grafs to that taken at the time the seed is ripe, as 10 to 11.

The quantity of latter math produce	3403	2	0
Quantity of nutritious matter	53	2	12

Proportional value of the latter math grafs to that of the time of flowering, as 4 to 10, and to that of the time the seed is ripe, as 4 to 11. See GRASS.

RAYA, in *Geography*, a river on the W. coast of Java, which runs into the sea, S. lat. $7^{\circ} 27'$. E. long. $107^{\circ} 30'$.

RAYEN, a town of the Rhenish palatinate; 11 miles N.W. of Heilbronn.

RAYGEN, or RAYHRAD, a town of Moravia, in the circle of Brunn; 8 miles S. of Brunn.

RAYLEIGH. See RALEIGH.

RAYMANGUR, a fortress of Hindoostan, in Myfore, taken in 1791 by the British troops; 15 miles E. of Nundhydroog.

RAYMATLA, a river of Bengal, which runs into the bay of Bengal, N. lat. $21^{\circ} 35'$. E. long. $88^{\circ} 49'$.

RAYMON, a town of France, in the department of the Cher; 14 miles S.E. of Bourges.

RAYMOND DE PEGNAFORT, in *Biography*, a saint in the Roman calendar, was a Spaniard by nation, and born at the castle of Pegnafort, in Catalonia, in the year 1175. He received the early part of his education at Barcelona, from whence he removed to the university of Bologna, where he studied the law, took his degrees, and afterwards taught the canon law for some time with great reputation. He was afterwards called to Barcelona, by Berenger, bishop of that city, who made him a canon, and provost of his cathedral church. He held these posts in the year 1218, when he established an institution which led the way to the foundation of the *Order of Mercy*, (see that article.) In 1222 he resigned his dignities, and became a member of the Dominican order of preaching friars at Barcelona. In 1230, pope Gregory IX. sent for him to Rome, appointed him his chaplain and confessor, and devolved on him the care of carrying on the compilation of the "Decretals." The pontiff would willingly have recompensed him for his labours by presenting him with very considerable church preferment, but he chose rather the quiet of a monastery to the honours and emoluments of the richest sees in Spain and Portugal, which were offered to him. In 1238 he was called to assume the post of general of his order; but upon the plea of his infirmities, he was suffered, in about two years, to return to his monastery, where he spent the remainder of his long life. He died in 1275, having entered on the 100th year of his age. To his everlasting disgrace, he is said to have been principally instrumental in introducing the Inquisition in the kingdom of Arragon, and into Languedoc, a circumstance which probably was the means of his canonization in the year 1601. He was author of "Summa de Cassibus pœni-

tentialibus, seu de Pœnitentia et Matrimonio," which was long popular in the Catholic world, and went through numerous impressions. The best edition of it is that published by father Laget, at Lyons, in 1708. Raymond's chief work is "Lib. V. Decretalium," commencing with the papacy of Alexander III., where the decretals of Gratian terminate, which was approved by pope Gregory IX., and constitutes the second volume of the papal canon law. Moreri.

RAYMOND LULLY, a philosopher of much celebrity in the dark ages, was born at Majorca in 1234. He was brought up a soldier, and led the life of a man of pleasure. Falling in love with a young woman, who was deaf to his addresses, on account of a cancer with which she was afflicted, and which she exhibited to his view, in order to make him desist from his importunities, he was so much affected with the sight, that he retired from the world, devoting himself to pious pursuits, and in the search of a remedy for the disease with which the object of his affection was afflicted; this was the chief motive for the chemical studies for which he became so famous. He undertook a course of travels into the East, for the purpose of converting the Mahometans to the Christian faith, and incurred very great hardships, and the most serious dangers. So great was his zeal for this object, that being unable to persuade certain Christian princes to engage in it, he entered into the Franciscan order, and returned to Africa, with the hope of obtaining the honour of dying a martyr. He was accordingly thrown into prison, and after suffering much torture, and long imprisonment, he was freed through the interest of some Genoese traders, who took him on board their ship to convey him home. He died just when he had arrived within sight of his native land, in the year 1315. As a chemist, his chief object was the pursuit of the philosopher's stone, and the universal remedy for all disorders. Boerhaave, who had perused the works of Lully, speaks highly of their merit; he finds them, he says, "beyond all expectation, excellent, so that he doubted whether they could be the work of that age. So full are they of the experiments and observations which occur in later writers, that either they must be supposititious, or the ancient chemists must have been acquainted with many things which pass for modern discoveries." Lully is supposed to have derived his chemical knowledge from his travels in the East, particularly from the writings of Geber. A complete edition of all the writings attributed to him, was printed at Mentz. Raymond Lully is chiefly celebrated for an invention by which he pretended to enable any one, mechanically, to invent arguments and illustrations upon any subject, and thus to reach the summit of science at a small expence of time and labour. This "Great Art" professes to furnish a general instrument for assisting invention in the study of every kind of science. For this purpose, certain general terms, which are common to all sciences, are collected and arranged, not according to any natural division, but merely according to the caprice of the inventor. An alphabetical table of such terms was provided, and subjects and predicates taken from these were inscribed in angular spaces, upon circular papers. The essences, qualities, affections, and relations of things, being thus mechanically brought together, the circular papers of subjects were fixed in a frame, and those of predicates were so placed upon them as to move freely, and in their revolutions to produce various combinations of subjects and predicates; whence would arise definitions, axioms, propositions, varying infinitely, according to the different application of general terms to particular subjects. Such is the general idea of the Lullian art, which, however applauded by certain writers of that

that period, may be pronounced as unworthy of notice, except as a specimen of the artifice with which men frequently impose upon vulgar credulity. Enfield's History of Philosophy.

RAYMOND, in *Geography*, a township of America, in Rockingham county, New Hampshire, incorporated in 1764, containing 898 inhabitants; 12 or 14 miles W. of Exeter.

RAYMOND, or *Raymond-town*, a post-town in Cumberland county, and district of Maine, containing 825 inhabitants; 142 miles N.N.E. of Boston. The land is generally level, excepting one large hill, called Rattlesnake-hill, from its abounding with those reptiles. The greater part of the growth is pine and white oak, and the soil is difficult of culture.

RAYNAL, WILLIAM-FRANCIS, in *Biography*, a French writer of celebrity, was born at St. Genies, in the Rovergue, in 1713. He entered at a very early age among the Jesuits, and by his abilities excited high expectations of his future celebrity. His dislike of restraint induced him to quit the society in the year 1748, although he had made his profession, and had been ordained priest. He now entered his career of authorship, and distinguished himself as a political, historical, and miscellaneous writer. His first piece, published the same year in which he quitted the society, was entitled "Histoire du Stadhouderat;" he next published "Histoire du Parlement d'Angleterre," which gained him much reputation, though it had little claim to the dignified title of history, and was, moreover, tinged with many prejudices, religious and political. He also composed "Anecdotes Littéraires," in three vols. 12mo.; and "Memoires de Ninon de l'Enclos," and was much employed in the "Mercure de France." The great work of the abbé Raynal was entitled "Histoire Philosophique et Politique des Etablissements et du Commerce des Européens dans les deux Indes," to the composition of which he was led by his engaging in some commercial speculations, thinking them likely to turn out more profitably than literary pursuits. His history was published in 1770, and as it contained history, description, and calculation, intermixed with political and philosophical reflections, and was, through the whole, animated by an ardent spirit of philanthropy, and hatred of tyranny, civil and religious, it became popular, and the author was looked up to as one of the reformers of the age. Critics, however, soon found that, as a literary and philosophical work, it would not bear the test of examination. The style, though rich, was exceedingly declamatory; the images were frequently inflaming; and his principles vitiated by the licentiousness of his country; and the facts upon which the whole was founded were derived from incorrect or dubious documents. The author, it should seem, was soon made sensible of the imperfections of his work, and determined to improve it by travel: with this view he visited the principal commercial towns in France, and passed into England and Holland, at every place making inquiries among travellers and merchants with the most unremitting assiduity. On his return, he published at Geneva an improved edition of his work, in 10 vols. 8vo. containing many additions and corrections. Its tone was unaltered, and its attacks upon existing authorities were so bold, that the parliament of Paris ordered it to be burnt, and issued a decree for apprehending the author. He retired to Spa, whence he travelled through Germany, and after having visited all the principal places, he returned to France, and lived some time quietly in the southern provinces. At the academies of Marseilles and Lyons he founded several prizes for essays on given subjects, of which the most re-

markable was whether the discovery of America had been more useful or prejudicial to Europe.

America has now, owing to the quarrel and war subsisting between Great Britain and its colonies, become an object of peculiar interest; and the abbé Raynal, in 1781, published "Tableau et Révolutions des Colonies Angloises dans l'Amerique Septentrionale," which was commented upon and exposed by Thomas Paine, who was a zealous and able defender of the American cause, against the mother country.

The abbé came to Paris in the important year 1788, when the revolution was just ready to burst forth. He had not been long in the city, before the National Assembly was convoked, and one of its early acts annulled the decrees passed against him; for this favour, he addressed a letter of thanks to the president, containing a retraction of certain principles contained in his work. Observing, afterwards, that the constituent assembly were occupied in decrees which he thought were violent infringements on the rights of property, and in others calculated to augment the popular effervescence, he wrote, in May 1791, a long letter of advice and remonstrance. It was soon seen that the sentiments in this letter were very different from those which were generally expected from the author of the "Histoire Philosophique," their tendency being to repress popular licence, and to strengthen the hands of civil authority. Raynal, like many other philosophers of that day, had aided all in his power to produce the change, at which, when put into practice, he and they were greatly alarmed. But it was now too late to return: they had shewn the people their power, had taught them their rights, which it was in vain to expect they would be induced to abandon for any arguments he could produce. In the letter referred to, he says, "I have long dared to speak to kings of their duty, suffer me now to speak to the people of their errors, and to their representatives of the dangers which threaten us. I am, I own to you, deeply afflicted at the crimes which plunge this empire into mourning. It is true that I am to look back with horror at myself for being one of those who, by feeling a noble indignation against arbitrary power, may perhaps have furnished arms to licentiousness. Do then religion, the laws, the royal authority, and public order, demand back from philosophy and reason the ties which united them to the grand society of the French nation, as if, by exposing abuses, and teaching the rights of the people and the duties of princes, our criminal efforts had broken these ties? But no!—never have the bold conceptions of philosophy been represented by us as the strict rule for acts of legislation." He next proves, that it was not the business of the assembly to abolish every ancient institution; that the genius of the French people is such, that they can never be happy or prosperous but under a well regulated monarchical government; and that if they wished not the nation to fall under the worst kind of despotism, they must increase the power of the king. Raynal was considered to be in his dotage, and himself and his writings were now disregarded. He retired in the midst of storms to Passy, where, being reduced to a state of indigence, he died in March 1794, at the age of 85. Besides the works already mentioned, the abbé Raynal published "The History of the Divorce of Catharine of Arragon, by Henry VIII.;" and "A History of the Revocation of the Edict of Nantes," in four volumes; but he committed many of his papers to the flames during the bloody reign of the monster Robespierre.

RAYNERIUS, a learned Italian monk, who flourished most probably in the 13th century, was a native of Pisa. He

He acquired the character of a consummate divine and civilian, and was appointed professor of divinity, as well as raised to the most considerable offices of trust and honour belonging to his order. It is uncertain at what period he died. He left behind him many works, of which the chief is entitled "*Pantheologia, seu, Summa universæ Theologiæ.*" This is a dictionary of theology, with the subjects disposed of in alphabetical order; it has been held in high estimation among the members of the Catholic communion. It has gone through several editions in folio and quarto. The last edition was printed at Paris in 1655, in 3 vols. folio, with additions of father Nicolai.

RAYNHAM, in *Geography*, a township of Massachusetts, in Bristol county, taken from Taunton, and incorporated in 1731. It contains 1154 inhabitants. Besides the great river Taunton, this township is watered by several streams, upon which are six saw-mills, three grist-mills, a furnace, a forge, and fulling-mill. Here are also numerous ponds, of which Nippanniquit, or Nippahonsit, is two miles long and one broad. In this pond millions of alewives annually resort and leave their spawn in it. An excellent kind of ore, and various kinds of fish, are found in this township. Besides the usual occupations of husbandry and mechanics, many of the inhabitants are employed in the manufactories of bar-iron, hollow ware, nails, iron for vessels, iron-shovels, potash, shingles, &c. The first forge set up in America was introduced into this town by James and Henry Leonard, natives of England, in 1652. The same family, in the 6th generation, now possess it. King Philip's hunting house stood on the northern side of Fowling pond, about one mile and a quarter from the pond. When the war broke out in 1675, which terminated in the death of the king and the ruin of his tribe, he left strict orders to all his Indians not to hurt the Leonards. Before Philip's time, Fowling pond was two miles long, and three miles and a quarter wide. But the water is now almost gone, and the large tract it once covered is grown up to a thick-set swamp of cedar and pine. The vicinity has abounded with excellent ore, which has supplied the forge for 80 years; it is, however, incapable of being wrought into iron of the best quality.

RAYNOLDS, or RAINOLDS, JOHN, in *Biography*, a learned English divine, was born at Pishoe, near Exeter, in the year 1549. In 1562 he was admitted a student at Merton college, Oxford, whence he was removed, in 1563, to a scholarship of Corpus Christi college. In 1572, having taken his degrees in the arts, he was appointed Greek lecturer in his college, in which department he acquitted himself with great applause. Fuller speaks of him in the highest terms as a commentator of Aristotle's *Rhetoric*. He had hitherto been zealously attached to the Popish religion, while his brother William was equally zealous for the Reformation. The difference in their sentiments leading them to frequent conferences and disputations, they made converts of each other, William becoming a determined Papist, and John a steady Protestant. He frequently appeared in the pulpit, and was greatly admired as a preacher. In the year 1588 he was admitted to the degree of doctor of divinity, and soon afterwards the fame of his great learning induced queen Elizabeth to appoint him professor extraordinary in that faculty at Oxford; after which she gave him the deanery of Lincoln, which he held only a short time, when he exchanged it for the presidency of Corpus Christi college, of which he was a fellow. He made this exchange from his attachment to an academical life, and his love of retirement and study. Similar motives led him afterwards to refuse a bishopric which queen Eliza-

beth offered him. He retrieved the finances of his colleges, which had been suffered to fall into dilapidation, and he restored its decayed discipline, strictly obeying the statutes himself, and compelling all the other members to observe them. After the accession of James, he was appointed, with Dr. Sparks, Mr. Chadderton, and Mr. Knewstubs, to appear on behalf of the Puritans in the pretended conferences at Hampton Court; of which we have a full account in the second volume of Neal's "*History of the Puritans,*" by Dr. Toulmin, p. 10—20. Dr. Raynolds did not on this occasion act according to his usual spirit, and, suffering himself to be browbeaten by the royal tyrant, lost much of the respect which his character usually laid claim to. It was at the conclusion of this conference, that the king said to Dr. Raynolds and his friends, in answer to their arguments; "If this be all your party hath to say, I will make them conform themselves, or else I will harrie them out of the land, or else do worse, only hang them, that's all." When James gave directions for undertaking a new and more correct translation of the bible, Dr. Raynolds was one of the Oxford divines who were commissioned to give a new version of the four greater prophets, the book of Lamentations, and the twelve minor prophets. While employed in this great work he was seized with the gout, under which he had been a sufferer many years, and which at length proved fatal to him. In the midst of the severest pains, he persevered in the task assigned to him, and once a-week his fellow-labourers at Oxford regularly assembled in his apartments, where they compared the fruits of their respective studies, determining what appeared to them to be the most faithful translation, till they had accomplished their task. Dr. Raynolds died in the year 1607, highly respected for his erudition, his piety, his modesty, and humility. Several of his biographers speak of him in the highest terms. Wood says he was most prodigiously seen in all kind of learning, and had turned over all writers, profane, ecclesiastical, and divine, all the councils, fathers, and histories of the church. He was author of many theological works, of which we may mention "*De Romanæ Ecclesiæ Idolotria, in Cultu Sanctorum, Reliquiarum, Imaginum,*" &c. 1596; and "*Censura Librorum Apocryphorum Veteris Testamenti, adversus Pontificios,*" which was a posthumous work, and printed at Oppenheim, in Germany, 1611, in 2 vols. 4to.

RAYNPOUR, in *Geography*, a town of Hindoostan, in Bahar; 40 miles N.W. of Chuprah.

RAYNULLAH, a town of Hindoostan, in Bahar; 32 miles E. of Bahar.

RAYPOUR, a town of Bengal; 55 miles W.S.W. of Burdwan. N. lat. 22° 48'. E. long. 87° 5'.—Also, a large and commercial town of Hindoostan, in the country of Ruttunpour; 55 miles S. of Ruttunpour. N. lat. 21° 24'. E. long. 82° 28'.

RAYPOUR, or *Ray-Gaut*, a remarkable pass on the Beyah river, about 17 or 18 cosses from Noorpour; situated a considerable way within the level country of the Panjab.

RAYTE, or RYCHIE, in *Ichthyology*, a name given by Joannes Cuba, Albertus, and others, to the common skate, or flaire. See *RAIA Batis*.

RAZANT. See *RASANT*.

RAZANT *Flank*. See *FLANK*.

RAZANT *Line of Defence*. See *DEFENCE*.

RAZBOINIKOVA, in *Geography*, a town of Russia, in the government of Irkutsk, on the Angara; 56 miles N.W. of Balaganikai.

RAZBOINOI, a fort of Russia, on the Ural; 92 miles E. of Orenburg.

RAZE,

RAZE. See **TUMB.**

RAZE, in the *Munge*. A horse is said to have *razed*, whose corner teeth cease to be hollow; so that the cavity, where the black mark was, is filled up; that is, wholly disappears, and the age of the animal cannot be known with any degree of certainty. See **MARK.**

RAZI, in *Biography*, one of the surnames of the famous Mussulman Mohammed Ben Omar Ben Khatid Rei, Al Temini Al Bekri, a native of the city of Rei, in the Persian Irak, of which the word Razi is the appellative. He was born in the year of the Hegira 543, corresponding with 1148 of the Christian era, and became one of the most celebrated doctors. His knowledge was not confined to the learning usually taught in the Mohammedan schools, but it comprehended likewise the sciences imported into the East with the writings of the Grecian sages. He was, moreover, a very eloquent preacher both in the Arabic and Persian languages. By these qualifications he acquired the favour of several princes, particularly of a sultan of the Gaurid dynasty, who erected a college for him in the city of Herat in Chorasan. He was driven from this situation by the intrigues of Cadi Abdalmegid, of the sect of Keramians, who contended that the deity was corporeal, and of human shape. Having challenged Razi one day to a public disputation on the attributes of God, he was so confounded by the superior reasoning of the latter in defence of the divine spirituality, that he became his bitter enemy, and seized every opportunity of calumniating him to the sultan, as a man who, under the cloak of philosophy, concealed irreligious and impious notions. By his persuasions, the prince banished Razi from the city, but he soon repented of his rash decree, and recalled him. This happened in the year 606 of the Hegira. He was author of an "Introduction to the most subtle Mysteries for the Use of Men of Genius," in which he explains the principles of the Mohammedan philosophy; and several other pieces. "Select Astronomical Researches" have been attributed to him, but perhaps on insufficient authority.

RAZI is also the surname of a celebrated philosopher, chemist, and astronomer, called Mohamed Ben Zakaria, a native of the same city as the preceding, who flourished under the caliphate of Moctader of the dynasty of the Abassides. He died about the year 922 of the Christian era.

RAZIMIERZ, in *Geography*, a town of the duchy of Warsaw, situated between Slepzka and Posen, where the unfortunate count Patkul was broken alive on the wheel, and impaled by order of Charles XII. of Sweden in 1708.

RAZNIPNAIA, a sort of Russia, in the government of Upha, on the Ural; 56 miles S.W. of Orenburg.

RAZOIS, PORT, a port at the S.W. extremity of the coast of Nova Scotia, and N.E. of cape Negro.

RAZOR, a well-known edged instrument used in shaving. Heat appears to give a partial increase of tenacity to a razor's edge, probably because the edge cools fastest, contracts, and is stretched.

RAZOR-Bill, in *Ornithology*, the common English name of the alca, a web-footed bird with no hinder toes, common on our sea-shores. See **ALCA Torda**.

RAZOR-Fish, in *Ichthyology*, the *Coryphæna novacula* of Linnæus, having the head and fins barred with blueish lines. See **NOVACULA**.

RAZOR Island, in *Geography*, a small island on the coast of Brasil; 12 miles S. of Rio Janeiro.

RAZUDA, a town of Hindoostan, in Guzerat; 40 miles E.S.E. of Chitpour.

RE, an island in the Atlantic, near the west coast of France, about 16 miles long, and 3 broad: separated from

the coast of Vendée by the straits of Breton, which are about 7 miles wide. The principal town is St. Martin de Ré. N. lat. 46° 13'. W. long. 1° 20'.

RE, in *Commerce*. See **REE**.

RE, in *Grammar*, &c. an inseparable particle, or preposition, prefixed to the beginning of words, to vary, double, or otherwise modify their meaning.

The modificative *re* was first introduced by the Latins, from whom it is borrowed into most of the modern tongues. Priscian derives it from *retro*, backwards; others rather derive *retro* from *re*; others derive *re* from the Greek *ῥεα*, *easy*; or from *ῥεω*, *I flow*.

The effect of the *re* is various: usually it signifies *again*, *re-sum*, *re-join*, *re-sign*, *re-sume*, *re-course*, *re-bound*, *re-cite*, *re-hear*, *re-cognize*, *re-compare*, *re-double*, *re-liquish*, &c.

Sometimes it stands for *contra*, *with*, *against*; as in *re-luctance*, *re-cumbent*, *re-cline*, &c.

Sometimes for *super*, *over*, as in *re-dundant*; sometimes for *longe*, *far*, as in *re-moving*, &c.

RE, in *Music*, the name of the second of the keys in the three hexachords of Guido, G, C, and F. See **SOLMISATION**, **GAMMUT**, **HEXACHORDS**, and **MUTATIONS**.

RE Alla Caccia, Il, the Italian title of a comic opera, taken from our "Miller of Mansfield." It was set to music for our opera-house in 1768, by Alessandri, a young composer of promising abilities. He was husband of La Guadagni, the original "Buona Figliuola" in Italy, and sister to Gaetano Guadagni, the celebrated singer. But the Miller of Mansfield was first formed into a comic opera for Paris, by Sedaine, and set by Monsigni, under the title of "Le Roi et le Fermier," in 1762.

RE Teodoro, Il, a comic opera, founded on the adventures and vicissitudes of the unfortunate Theodore, king of Corsica. The music of this drama is one of the innumerable instances of the fertility of Paefiello's pen. It had been performed all over Italy and Germany with the greatest applause, previous to its being brought on our stage. The music, that was not changed, is extremely original and pleasing, particularly the *finales*. There was a mixture of airs by Corri, Mazzinghi, and Storace; but besides destroying the unity of style, the certainty of there being merit of some kind or other in every composition of Paefiello, inclines lovers of music to lament that any of his airs should be changed or omitted.

REA, in *Geography, a river of England, which runs into the Tame, 3 miles N.E. of Birmingham.*

REA, *Lough*, a lake of Ireland, in the county of Galway, on the border of which is the town of Loughrea. See **LOUGHREA**.

REACH, in *Sea Language*, the distance between any two points on the banks of a river, in which the current flows in a straight uninterrupted course.

RE-ACTION, in *Physics*, the action by which a body acted upon, returns the action by a reciprocal one upon the agent.

The Peripatetics define re-action to be that which a passive body returns upon the agent, by means of some quality contrary to that received from it, in the same part with which the agent acted, and at the same time; as if water, while it is heated by the fire, does at the same time cool the fire.

It was known, even in the schools, that there is no action in nature without re-action; and it was a maxim among them, *omne agens, agendo repaatur*.

But the equality of the actions was not known. Sir Isaac Newton established it as one of the laws of nature, that

action

action and re-action are equal and contrary; or that the mutual actions of two bodies, striking one against another, are exactly equal, but in contrary directions; or, in other words, that by the action and re-action of bodies one on another, there are produced equal changes in each: and those changes are impressed towards directly contrary parts or ways. See *Laws of NATURE*.

Some of the school-philosophers deny any such thing as re-action, properly so called, at all; urging, that action arises only from the ratio of the greater inequality; that is, we are only to account for action the excess of action, or what the agent does more than is returned by the patient. But the equality between action and re-action sets aside this exception.

READ, in *Geography*, a river of England, in the county of Northumberland, which runs into the Tyne, 10 miles N. of Hexham.

READ Head, a cape on the E. coast of Scotland. N. lat. $56^{\circ} 35'$. W. long. $2^{\circ} 28'$.

READFIELD, a post-town of America, in Kennebec county, and district of Maine, bounded on the E. by Hallowell, and separated from Sterling on the W. by the eastern branch of the Androscoggin river; 8 miles W. of Hallowell, and 190 N.E. of Boston. It contains 1396 inhabitants.

READING, *JOHN*, in *Biography*, organist, first at Lincoln, then at Hackney, and finally of St. Dunstan's church in Fleet-street, London. He was a scholar of Dr. Blow, and Stanley's first master. He published Hymns early in life, for psalmodists in parochial congregations; and, lastly, a work engraved on copper, which he called "A Book of my Anthems, with a Thorough-bass, for the Organ or Harpsichord." He died in 1766, far advanced in years.

READING, in *Geography*, a borough and market-town in the hundred of Reading, and county of Berks, England, is 38 miles W. by S. from the metropolis. It is a town of considerable extent and importance, and contains, according to the parliamentary returns of 1811, 2032 houses, and 10,788 inhabitants.

Historical Events.—Reading is unquestionably of very great antiquity; but whether it is indebted for its origin to the Britons, the Romans, or the Saxons, is unknown. Conjectures, however, have been hazarded on the subject by various writers. Camden thinks its foundation ought to be referred to the Britons; Leland calls it the Pontes of Antoninus; and Dr. Beke, the learned professor of modern history at Oxford, considers it the Calleva of Richard of Cirencester. But the circumstances which are alleged in favour of these opinions, by their respective authors, are far from being satisfactory. This place is first mentioned in history, under its present appellation, in the year 871; at which time it is described by Asser as being a fortified town, belonging to the Saxon kings, but then occupied by the Danish invaders, who had retreated hither after their defeat at Englefield. The victorious Saxons immediately invested the town; but their enemies, having received reinforcements, attacked the besiegers with such impetuosity, that, after an obstinate contest, they deemed it prudent to retire to Ashdown. Hither they were followed by the Danish forces, which were again overthrown, and driven back to Reading. Here the latter remained unmolested till the following year, when they marched to London. In the reign of Alfred, who mounted the throne of Wessex soon after this event, the Danes once more seized upon Reading, and they doubtless possessed it occasionally during their incursions in the tenth century. Throughout that long period of incessant

hostility and depredation, however, this town seems to have escaped any very serious disaster; but in 1006 it was reduced to ashes by Sweyn, king of Denmark, along with its famous nunnery, said to have been founded by Elfrida, widow of king Edgar, as an atonement for the murder of Edward the Martyr. Reading soon recovered from this disaster, and in the course of a century afterwards became a place of considerable importance. In 1121 king Henry I. laid the foundation of its magnificent abbey, in which his remains were subsequently interred, according to his own desire. Stephen, who usurped the throne after Henry's death, built a castle here, which was surrendered to his antagonist Henry Fitz-Empress, who no sooner obtained the crown, than he ordered it to be demolished; so that even the site of it is now uncertain. That monarch, however, otherwise evinced much partiality for Reading. Here he passed much of his time, and convened a parliament, as also an ecclesiastical convocation, in which Baldwin was elected archbishop of Canterbury. The abbey church was finished in this reign, and dedicated in presence of the king. In 1185 he came hither from London, to receive Heraclius, patriarch of Jerusalem, who presented him with the keys of the holy sepulchre, and the royal banners of Jerusalem, which Henry returned. In the reign of his successor, Richard I., a convention for the trial of Longchamp, chancellor and bishop of Ely, who had been appointed regent of the kingdom during the king's absence, was held here. King John also held a convention in this town, in 1206; and in 1212 a council was convened here by the pope's legate, for the purpose of effecting a reconciliation between that infatuated prince and the exiled bishops. In 1213 the king met the legate and barons at the abbey, and held a parliament. King Henry III. spent his Christmas at Reading in 1226; and twice during his reign summoned the estates of the realm hither, for the transaction of national business. He was the first monarch who granted a charter of incorporation to the town. In 1346, Edward III. held a great tournament here; and in 1359, the marriage of his son, John of Gaunt, with Blanche, daughter of Henry, duke of Lancaster, was solemnized in the abbey church. In 1384, Richard II. and his court, together with the mayor and aldermen of London, being assembled at Reading, John Northampton, the preceding mayor of that city, was convicted before them of seditious practices, and sentenced to perpetual imprisonment. In 1389 a great council was held at Reading, at which the king and his barons were reconciled by John of Gaunt. Parliaments were held here also in 1440 and 1451; in the former of which the order of nobles called viscounts was first established; and in the year following, the parliament adjourned hither from Westminster, on account of the plague. King Edward IV.'s marriage with Elizabeth, lady Grey, was first acknowledged at Reading, in 1464; on which occasion she made her public appearance at the abbey, conducted by the duke of Gloucester and the earl of Warwick. In 1466 parliament was a second time adjourned to Reading, to avoid the plague. King Henry VIII. frequently resided here, having converted the dissolved abbey into a palace. His son, king Edward VI., visited this town in 1552, when he was met by the mayor and aldermen at Coley-Crofts, and presented with two yokes of oxen; the mayor riding before him, uncovered, to the palace. The same ceremony was repeated, when Reading was visited by the bigotted Mary, and her husband, king Philip of Spain. Queen Elizabeth was a frequent visitant here, and had a seat in the church of St. Lawrence.

Early in the reign of Charles I., when the plague raged

with great violence at London, the courts of chancery, king's bench, and common pleas, were held here, as were likewise the court of exchequer, the court of wards and liveries, and the court of requests. In 1642, Reading was a parliamentary post, but the garrison, being defective as to ordnance and ammunition, quitted the town, without resistance, on the approach of a party of the king's horse. In consequence of this event it became a royal garrison, and continued to be so till taken by the earl of Essex in April 1643, after a siege of eight days. The king, however, again recovered it in September the same year, and held it till May following, when he ordered the works to be demolished, and evacuated the town. After this event Reading was frequently occupied as the head-quarters of the parliamentary army, and was consequently much impoverished by the contributions levied upon its inhabitants for the support of the military. In 1688 the army of king James II. was quartered in this town, but quitted it on the approach of the prince of Orange. On this occasion a skirmish took place in the market-place between two detachments of horse, which terminated in favour of the Protestant interest, and is still commemorated, by bell-ringing, on the anniversary of its occurrence. Queen Anne visited Reading in 1700, when she was received by the corporation in state, and presented with forty broad pieces of gold in an elegant purse made for the occasion.

Municipal Government.—Reading claims the honour of having been originally constituted a guild, by charter from Edward the Confessor. This claim, however, is extremely questionable; and at all events we feel convinced that the ancient guild was nothing more than an association of mechanics and tradesmen for their individual benefit. The first monarch who conferred upon Reading the privilege of separate jurisdiction was Henry III., in the 37th year of his reign. His charter was subsequently confirmed by all his successors, but without any material alterations, till the reign of Henry VI., when the corporation is first mentioned by the title of the mayor and burgesses. Thus it continued to be designated till queen Elizabeth divided the burgesses into capital and secondary, and declared the mayor and them to be a common council for the borough. That princess further conferred upon the corporation considerable estates. Charles I. authorized aldermen to be elected, and invested the mayor and them with ample powers for the government of the town. This charter was confirmed, after the restoration, by his son Charles II., and is the one under which the corporation now acts. By it the officers are declared to be a mayor, twelve aldermen, and the same number of capital burgesses; the mayor, and his deputy, (the preceding mayor,) the senior alderman, the bishop of Salisbury, and his chancellor, being justices of the peace for the borough, and empowered to hold sessions, and a court of record. The recorder is an officer added by Charles II., who likewise first acknowledged the town-clerk. Reading sent members to parliament from the time of the earliest records. Before 1716 the right of election was vested in the freemen not receiving alms, and in the inhabitants paying scot and lot; but in that year it was limited, by a decision of the house of commons, to the inhabitants paying scot and lot only. The number of voters is estimated at 560, and the mayor is the returning officer. The spring assizes for the county are held at this town, as are likewise the Epiphany sessions, but the summer assizes are held at Abingdon, and the Michaelmas, either there or at Reading, as the magistrates may judge most convenient.

Reading is a town of considerable extent, situated on both banks of the river Kennet, which separates itself into

several branches in passing through the town. It contains three parishes, St. Giles, St. Mary, and St. Lawrence, and is divided into five wards, called the High-ward, New-ward, Minister-ward, Old-ward, and London-ward, for each of which a constable is appointed. Formerly it was a place of great trade in woollens, but that manufacture fell to decay during the seventeenth century, and has never since revived. At present the chief manufactured products are, coarse linens, (such as sheeting, sail-cloth, floor-cloth, and sacking goods,) gauze, crapes, muslinets, ribbons, hat-bands, shoe-strings, and other similar articles. These afford employment to a great portion of the inhabitants among the lower orders; but the principal support of the town arises from its water communications with London, Bath, and Bristol. The articles exported are, flour, of which 20,000 sacks are sent annually to the metropolis, timber, bark, straight hoops, linen, wool, cheese, beer, and a variety of minor articles: in exchange are received groceries of every kind, iron, spirits, fir timber, deals, staves, Portland stone, bricks, hemp, flax, hides, leather, coals, Bath free-stone, Birmingham goods, &c. For the convenience of trade, several wharfs are formed at Reading, and many improvements have been lately made in the internal navigation of the district at large.

This town, from time immemorial, has been noted for its markets, which are held weekly, on Wednesday and Saturday. The Wednesday's market is chiefly for fruit; but that of Saturday embraces corn and every article of provision. The spot on which the corn market is held, is a spacious piece of ground, of a triangular form, environed by commodious shops for the accommodation of people attending the market, who may be supplied here with colonial or manufactured goods cheaper than in any other town in the county. This market-place is kept in repair by the corporation, for which they are entitled to take one pint out of each sack of corn sold in the market, amounting to about 54,600 quarters annually. The provision market buildings adjoin to the corn market-place, and form a long square, consisting, one-half of two ranges of butchers' shops, and the other half of apartments for the market-women, who bring butter, eggs, poultry, &c. for sale. At the southern end of this building is a square open area for fishmongers' and hucksters' stalls, and next to this, and fronting a street called Fisher-street, is a large square gate-way, over which is the house occupied by the clerk of the market. Besides these market-places, there is another for the sale of store pigs, conveniently situated between Friar-street and Broad-street. This is private property, but the corporation receive the toll. At Reading are four annual fairs, one on the 2d of February, another on the 1st of May, a third on the 25th of July, and a fourth on the 21st of September. The three first are chiefly for the sale of horses and cows; but the last is also a statute fair for the hiring of servants, and is further remarkable for the quantity of cheese brought hither from the counties of Gloucester and Wilts. Hops are also plentiful at this fair.

The houses of Reading are mostly constructed of brick, and are generally disposed in regular streets, some of them very narrow, which have been paved under the authority of an act of parliament, passed in the year 1785.

The principal public buildings and institutions in the town are the three churches of St. Lawrence, St. Mary, and St. Giles, and several dissenting meeting-houses, the town-hall and free-school, the blue-coat school, the green school, the foundation school, the school of industry, the Lancastrian school, the school for national education, the theatre, and the county gaol.

The church of St. Lawrence was chiefly erected towards the close of the 16th century, and is partly constructed of materials taken from the buildings of the abbey. Among the parts of it, so pilfered from the monastery, is a large doorway, which is composed of a circular arch, ornamented with rich mouldings, from which were suspended on each side the arms of the abbey; but these are now nearly obliterated. This doorway is likewise ornamented with niches, in which statues formerly stood. The advowson of the church belongs to St. John's college, Oxford. St. Mary's church is somewhat more ancient than that of St. Lawrence, having been constructed about the year 1547, in the stead of a previous one, which had gone to decay. Some portions of this building have evidently belonged to an older edifice, particularly a window over the west door, which is in the early pointed style of architecture. St. Giles's church was probably constructed at the commencement of the 12th century. The tower only is modern, the ancient one having been demolished during the civil war. The livings of both the churches last mentioned are in the gift of the lord chancellor. The principal meeting-houses for dissenters are the Calvinistic or Independent meeting-house in Broad-street, a Baptist meeting-house and a Quaker's meeting-house in Church-street, a Methodist chapel in Castle-street, and another in Minster-street, a Cudworthian and an Unitarian meeting-house in London-street, and a Catholic chapel in Vastern-lane. Another meeting-house for Baptists has also been lately erected in Sievier-street.

The town-hall and free-school form one building; the free-school occupying the ground story, and the hall, court-room, and offices, the floor above. The free-school was established in the reign of Henry VII., by John Thorne, abbot of Reading, with the funds of a suppressed almshouse. This school has two scholarships in St. John's college, Oxford, the gift of sir Thomas White, in 1557. Julius Palmer, one of the masters of this school, fell a martyr to his Protestant tenets in 1556. The blue-coat school, which is so named from the dress of the scholars, was founded in 1656, by Mr. Richard Aldworth, who bequeathed 4000*l.* for the support of a master, lecturer, and twenty boys. The present school-house is of late erection, and consists of a centre and two wings. Several donations and bequests having been made to this establishment by various persons, it now usually supports about 48 boys. The green school is situated in Broad-street, and is appropriated for the education of the daughters of decayed tradesmen, residents in the town, and of orphans, who have been left unprovided for by their parents. The inhabitants of Reading are indebted for the institution of this school to the Rev. Charles Sturges, the Rev. Dr. Nicholls, and the Hon. and Rev. W. B. Cadogan, former vicars of the three parish churches belonging to the town. It is supported by annual subscription, and the proceeds of different donations and bequests. In the foundation school, founded in 1766, eight male and eighteen female children are taught to read. It was instituted with a legacy left for that purpose by Mr. Joseph Neale. The school of industry originated under the patronage of Mrs. Cadogan, for female children, and is supported by the voluntary contributions of ladies in the town. The Lancastrian school, established in 1810, is situated in Southampton-street, and is attended by about 320 boys, who are nominated by the subscribers individually. The school for national education was opened in September, 1813. It is founded on the plan of instruction recommended by Dr. Bell, and is chiefly supported by the clergy of the town and county. Both these institutions are calculated to be highly beneficial to the rising generation. Besides these seminaries of

education, there are in Reading several Sunday schools, all the children attending which receive a suit of clothes annually, from a fund provided by the bequest of Mr. Edward Simeon, who clothed them in the same manner during his life-time. The theatre of Reading is a neat and convenient building, lately erected, under the act for regulating provincial theatres. The gaol was built in 1793, on the site of some of the abbey ruins. It is a large edifice, and contains commodious apartments for the keeper, a neat chapel, an infirmary, and a room for the reception of the magistrates, in the centre; and two wings, one for male, and the other for female prisoners, with yards, cells for refractory individuals, &c.

Besides the above public buildings and establishments, there is a public library lately established at Reading, under the name of the "Reading Institution;" also a dispensary, which is attended by some of the medical gentlemen of the town. The house is the property of the corporation, and the general expences are defrayed by subscription. The Oracle may likewise be reckoned among the public buildings of Reading. This structure was erected by the mayor and burgesses, in conformity to the will of John Kendrick, who left 7500*l.* "to build a strong house of brick, fit and commodious to set the poor to work therein." The funds of this charity having been at different periods greatly abused and misapplied, the subject has been several times before the supreme courts of justice. The testator's object, in bequeathing his large legacy, was the improvement of the woollen trade; but instead of this, it was perhaps the first occasion of the decay of that manufacture, by enabling such as could obtain its advantages to undersell those who were not so fortunate. The same complaints are made against it, with respect to the manufactures now carried on in it, and, as we suspect, not without some show of reason.

Monastic Establishments.—As already mentioned, the earliest religious institution at Reading was a monastery for nuns, founded by Elfrida, the mother-in-law of Edward the Martyr. This nunnery was founded in 979, and was destroyed, in 1009, by the Danes. The precise site on which it stood is uncertain, but there can be no doubt of its existence. It appears from the Domesday-book, and also from Tanner's Notitia, that another nunnery was established here at a later period, but nothing of its history is known. The abbey, the ruins of which are still sufficient to attest its extent and importance, was founded by Henry I. in 1121. It occupied a spot of ground, equal, if not superior, to any in Berkshire for fertility of soil and beauty of situation. This spot comprehended about thirty acres, and was environed on three sides by a massive and lofty wall, and on the fourth by the river Kennet. Exterior to this wall was a piece of ground, about fifty yards wide, (like the pomerium that surrounded the Roman cities,) which it was not allowable either to cultivate or build upon. It had four entrances to it, defended by arched gateways, and having battlements on their tops similar to those on the walls. Within these was the outer court, whence another gate-way led into the inner court. Part of this building remains, and is composed of bricks, chalk, and stone; and, from the dissimilarity of styles which it exhibits, has evidently undergone many alterations and repairs. Some of it is probably as late as the reign of Henry VII., though other portions of it are, undoubtedly, of much higher antiquity. The inner court conducted to the principal entrance to the abbey, the situation of which, owing to the ground having been since built upon, and the confusion occasioned by throwing up the ramparts in the civil war, cannot now be accurately determined. The only entrance on this side at present is through an arched passage, opening into the south-east corner of the cloisters, which is

certainly too mean to be supposed to have been the grand entrance to this superb monastery. On the right-hand of the passage is a door-way, leading to a range of apartments, and within is a circular staircase, which conducts to the upper part of the building. This division of the abbey is conjectured to have been appropriated as offices for servants and others, as, underneath it, is a series of arched cellars, and at its southern extremity was the kitchen. The great hall, or refectory, was entered from the cloisters by three large entrance doors. It measured 80 feet in length, 40 in width, and the same in height, to the centre of the ceiling, which was constructed of stone, and supported by arches springing from four pilasters, 20 feet high, placed against each of the side walls. These walls, and probably also the outer ones in every part of the building, measure twelve feet thick from the foundation to the set-off, and six feet thick from thence to the top, and are composed of flints and rubbish of various kinds, bedded in mortar, and indurated in the highest degree. The abbey-church appears to have extended 260 feet in length, and to have been built in the form of a cross, with a tower and spire in the centre. The nave was 40 feet wide, and was divided from the side-aisles by alternate piers and arches. From the massive character of this structure, in general, and from the circular form of the windows in the dormitory, it is conjectured that its windows also had circular arches. In the ground to the east of the church, many skeletons have been discovered, a circumstance which points it out as the probable burial-place of the monks. The above-mentioned buildings constituted the body of the abbey, but there were likewise many others, both connected with and detached from them. Among these were the infirmary, the stables, and the mill. This last is yet standing, and appropriated to its original purpose. It is a substantial edifice, built of flint and stone, and is probably coeval with the abbey-church.

Reading monastery was indubitably among the most distinguished in England. The monks were of the Benedictine order, and were endowed with many privileges and immunities, not only by the founder, but by several of his successors, and by some of the popes. They had the right of coining granted to them by king Edward III., also the right of holding three annual fairs, and a market every Sunday at Thatcham. The abbot was among those entitled to sit, and took precedence in the house of peers, next after the abbots of Glastonbury and St. Alban's. He was lord of the manor of Reading, and possessed otherwise much influence in the government of the borough. Many of the monks were distinguished for their talents and their acquirements in the learning of their respective ages. Robert of Reading, one of the first monks, was particularly famous, as being, with Adelard of Bath, the only Englishmen of their time who were masters of the Arabic language. The abbey-church was the place of sepulture of many royal and noble persons, among whom were Henry I., and his second queen, Adeliza, and probably also his first queen, Matilda; the empress Maud, and William, eldest son of Henry II.; Constance, grand-daughter to Edward III.; Ann, countess of Warwick; Richard, earl of Cornwall, and king of the Romans; and Richard de Curtenay, natural son of Henry II. At the dissolution, the revenues of this monastery were estimated at 2116*l.* 3*s.* 9*d.* annually, above 20,000*l.* according to the present value of money. The lands, of course, were seized upon by king Henry, who parcelled them off, either in gifts or in lease, to different individuals; but the monastery itself was converted into a royal palace, and continued to be occasionally occupied by our kings till its destruction during the grand rebellion, in the reigns of Charles I. and II.

The other monastic institutions in Reading, besides those already noticed, were two convents for Franciscan or Grey friars, St. Edmond's chapel, and Colney chantry. One of the convents was founded about the middle of the thirteenth century, soon after the first appearance of the Franciscan order in this country. Its original situation was on a marshy ground adjoining the Caversham road, and still called the Friery Mead; but in 1285 the friars removed to their subsequent residence, at the western extremity of Frier-street. After the dissolution this house was appropriated as a work-house for the poor; and part of the church now forms the borough prison. This building is in the early pointed style, and has at its western end a very beautiful lancet window. The other convent stood in Cattle-street, probably on the spot now occupied by the Methodist chapel. This institution seems to have been on a very small scale, though it is mentioned by Leland as "a fayre house of Grey freres." St. Edmond's chapel stood on the rising ground, called Chapel Hill, near the borough prison. It was founded, in 1284, by Lawrence Burgeis, then bailiff of the town. In the civil war it was converted into a fort; and afterwards, about the year 1750, was demolished, and another chapel erected in its stead on Battle-Farm. Colney chantry was instituted by one of that family in the reign of Richard II., for the souls of king Edward III., of Thomas Colney, John Colney, and William Catour. It had distinct incumbents of its own, and was under the patronage of the corporation.

Reading has given birth to several persons of eminence. Sir Thomas White, founder of St. John's college, Oxford, is said to have been born here; but Fuller affirms that he was a native of Rickmansworth. Archbishop Laud was born in this town in 1573, having been the son of William Laud, then a clothier in Broad-street, who, as the archbishop himself told lord Say, had borne all offices in the corporation, save the mayoralty. John Blagrave, the mathematician, is also commonly reputed to have been a native of Reading; as was Joseph Blagrave, a celebrated astrological writer, who does not seem to have been related to the mathematician. The other distinguished natives of Reading were, sir Thomas Holt; sir John Barnard, a noted alderman of London; James Merrick, the translator of the Psalms; William Baker, a learned printer; sir Constantine Phipps, lord chancellor of Ireland; and Dr. Phaulcon Bacon, author of several dramas, &c.

The vicinity of Reading presents several objects worthy of notice. At a short distance to the southward, close to a place called Catfild-lane, may be seen a remarkable stratum of oyster-shells, imbedded in a vein of sea-sand, at least twenty fathoms beneath the surface of a hill. This stratum is from one to two feet in thickness, and extends through a circumference of five or six acres of ground. Mixed with the shells is a considerable quantity of small teeth, apparently of fish. Caversham, formerly a seat of the Craven family, and afterwards of the Cadogans, is situated nearly opposite the town, on the north bank of the river Thames. The house was built by the earl of Cadogan, in the reign of George I., but has since undergone material alterations. In the old mansion, Anne of Denmark, queen to James I., was splendidly entertained by lord Knowles, when on her journey to Bath, in 1613. At the time Charles I. was a prisoner at Windsor, the parliament, through the mediation of general Fairfax, permitted him to visit Caversham Lodge, where all his children who were in England then resided, in the custody of the earl of Northumberland. In the hamlet of Woodley is a very pleasing seat, belonging to lord Sidmouth; and two miles to the westward

westward is another, the property of the Blgrave family. The park is very extensive, and is noted for fine venison. South-east, about the same distance, is White-Knights, the seat of the marquis of Blandford. Sunning, celebrated in history as having been for some time the seat of the see of Wiltshire, and subsequently the seat of one of the palaces of the bishops of Salisbury, is a village three miles to the eastward, on the road to Maidenhead. Leland mentions the bishop's palace as standing in his time. It was given by bishop Ghealt, along with the manor, to queen Elizabeth, in exchange for estates in Dorsetshire. The antiquity of this place is strongly marked by the sepulchral monuments in the church. Close to Sunning is an elegant mansion, the seat of Charles Fyfe Palmer, esq. Lysons's *Magna Britannia*, 4to. Berkshire. Beauties of England and Wales, vol. i. by John Britton and E. W. Brayley, 1801. The History and Antiquities of Reading, by John Mann, 4to. 1814. From the latter work, the chief and most essential parts of this account have been obtained: and those who wish to possess the most copious and authentic history of Reading will procure this volume.

READING, a township of America, in Fairfield county, Connecticut, S. of Danbury adjoining. It contains 1717 inhabitants.—Also, a large township of Middlesex county, in the state of Massachusetts, incorporated in 1644, and containing 2228 inhabitants, many of whom are employed in the manufacture of shoes, from 2 to 300,000 pair being annually exported; 12 miles N. of Boston.—Also, a township of Vermont, in Windsor county, W. of Windfor, adjoining. It contains 1565 inhabitants.—Also, a beautiful post-town, and the capital of Berks county, Pennsylvania, situated on the N.E. side of Schuylkill river; 54 miles N.W. of Philadelphia. This town is regularly laid out, and flourishes: its inhabitants are chiefly German: the borough and township contain 3462. The public buildings are, a stone gaol, a court-house, an elegant church for German Lutherans, erected in 1793, a church for Calvinists, one for Roman Catholics, a meeting-house for Friends, and a large edifice for the public offices. In the neighbourhood are 10 fulling mills, and several iron-works: and at the distance of 10 miles, on the road to Harrisburgh, is a spring, about 15 feet deep and 30 feet wide, from which issues a copious stream, containing some fine trout. In 1795 the sum of 12,000*l.* was voted by the county for building a stone arched bridge over the Schuylkill, at this town, on the high road to Harrisburgh. N. lat. 40° 21'. W. long. 75° 55'.—Also, a township of Adams' county, in Pennsylvania, containing 732 inhabitants.

READING. See LECTIO.

READING of a Deed. See DEED.

READINGS, in Criticism. Various readings, *variae actiones*, are the different manners of reading the text of authors in ancient manuscripts; where a diversity has arisen from the corruption of time, or the ignorance of copyists.

A great part of the business of the critics lies in settling the readings, by confronting the various readings of the several manuscripts, and considering the agreement of the words and sense. The various readings in the bible, (see HEBREW BIBLES,) and in the classic authors, are almost innumerable.

READINGS are also used for a sort of commentary or gloss on a law, text, passage, or the like; to shew the sense an author takes it in, and the application he conceives to be made of it.

READINGTON, or RIDDENTON, in Geography, a town of New Jersey, in Hunterdon county; 17 miles

N.W. by W. of New Brunswick. It contains 1797 inhabitants.

READ'S BAY, a road for ships on the W. coast of the island of Barbadoes, between Huletown and Speightstown; half a mile broad. Ships may anchor here in safety, in six to twelve fathoms water, the ground being soft ooze, defended from all winds, except the west, which blows right into the bay. N. lat. 13° 7'. W. long. 59° 47'.

READSBOROUGH, or REEDSBOROUGH, a post-town of America, in Bennington county and state of Vermont; 435 miles from Washington. It contains 410 inhabitants.

RE-AFFORESTED, is where a forest, having been disafforested, is again made a forest. As the forest of Dean was, by an act of parliament in the 20th of king Charles II. See FOREST.

RE-AGGRAVATION, in the Romish *Ecclesiastical Law*, the last monitory, published after three admonitions, and before the last excommunication.

Before they proceed to fulminate the last excommunication, they publish an aggravation, and a re-aggravation. Fevret observes, that in France the minister is not allowed to come to re-aggravation, without the permission of the bishop or official, as well as that of the lay judge. See EXCOMMUNICATION.

REAL, in Geography, a town of Syria, in the pachalic of Aleppo, situated in a country that abounds with olives, of which considerable quantities are prepared, and sent to Persia and other parts. This is the residence of an Aga; 36 miles S.S.W. of Aleppo.

REAL, REALE, is applied to a being that actually exists; in which sense it coincides with *actual*.

REAL, in Law, is opposed to *personal*.

REAL *Action*, that by which the plaintiff lays title to land, &c. See ACTION.

Customs are said to be real; that is, they determine all inheritances within their extent; and none may dispose of them, but according to the conditions allowed by the customs where they are situated.

REAL *altitude*, *affets*, *character*, *chattels*, *covenant*, *distinction*, *distress*, *estate*, *horizon*, *optic place*, *patronage*, *privilege*, *qualities*, *root*, *services*, *suit*, and *writs*. See the several substantives.

REAL, in Commerce, a Spanish money of account, of which there are four different sorts. The real vellon is that which is most general; it consists of 8½ quartos, 17 ochavos, or 34 Maravedis vellon. Madrid, and the whole of Castile, with most of the adjacent provinces, and also Bilbao, Malaga, and Galicia, keep accounts in reals and Maravedis vellon. The real of *new plate* (real de plata nuevo, or provincial) is double the real vellon: it is worth 17 quartos, or 34 ochavos: and it is also reckoned at 34 Maravedis of new plate. This real is represented by an effective coin of base silver, but books are not kept in any part of Spain in this money.

The real of *old plate* (real de plata antigua), mostly called the real of plate, is chiefly used in foreign commerce and exchanges: it is worth 16 quartos, or 32 ochavos: and it is also reckoned at 34 Maravedis of old plate. Cadiz and Seville keep accounts in reals and Maravedis of old plate.

The real of *Mexican plate* (real de plata Mexicano) is used in transactions with Spanish America, where accounts are mostly kept in hard dollars, reals, and quarters, and sometimes in sixteenths: 8 Mexican reals make 1 hard dollar (peso duro): this coin is worth 10 reals of new plate, 10½ reals of old plate, or 20 reals vellon. Thus, 1 real of new plate = 2 reals vellon: and 4 reals Mexi-

can = 5 reals of new plate: 64 Mexican reals = 85 reals of old plate: 2 Mexican reals = 5 reals vellon: 16 reals of new plate = 17 reals of old plate: 17 reals of old plate = 32 reals vellon. The pistole of exchange (dobloon de plata) is worth 32 reals of old plate, or 60 reals 8 Maravedis vellon. The dollar of exchange (pefo de plata) is worth 8 reals of old plate, or 15 reals 2 Maravedis vellon. The ducat of exchange (ducado de plata) is worth 11 reals 1 Maravedi of old plate, or 20 reals 25 $\frac{1}{2}$ Maravedis vellon. But, in commercial transactions within the country, the dobloon is reckoned only at 60, the pefo at 15, and the ducat at 11 reals vellon.

The coins now current in Spain are as follow:

	Reals Vellon.	Maravedis Vellon.
In gold.—The dobloon of 8 escudos, or quadruple pistole, passing for - - -	320	
The dobloon of 4 escudos, or double pistole - - -	160	
The dobloon de Oro, or pistole - - -	80	
The escudo - - -	40	
The coronilla, or vein-ten de Oro - - -	20	
In silver.—The dollar, or pefo duro - - -	20	
The half dollar, or escudo vellon - - -	10	
The peceta Mexicana - - -	5	
The real of Mexican plate - - -	2	17
In base silver.—The peceta provincial - - -	4	
The real of provincial plate - - -	2	
The real vellon - - -	1	
In copper.—The piece of two quartos - - -	-	8
The quarto - - -	-	4
The ochavo - - -	-	2

From 1730 to 1772, the gold was 22 carats, and the silver 11 dineros fine (the dinero = 24 grains): but in 1772 the gold was reduced to 21 $\frac{1}{2}$ carats, and the silver to 10 $\frac{3}{4}$ dineros fine, the pecetas and reals being reduced to

9 $\frac{3}{4}$ dineros fine. In 1786 the standard of the gold was again reduced to 21 carats for the different dobloons and their divisions; and to 20 $\frac{3}{4}$ carats for the coronilla or vein-ten de Oro. For the value of the pistole, see PISTOLE.

The dollar (coined since 1772) contains 374 $\frac{1}{2}$ troy grains of fine silver, or 405 $\frac{1}{2}$ grains of English standard silver: its value therefore in English silver coin is 4s. 4 $\frac{1}{2}$ d.; and the half dollar in proportion. The value of the pefo of plate, or dollar of exchange, in English silver coin, is 39 $\frac{1}{2}$ d.; of the dobloon of plate, or pistole of exchange, 13s. 2d.; and of the ducat of plate, 4s. 6 $\frac{1}{2}$ d. The real of old plate is worth about 5d.; and the real vellon 2 $\frac{1}{2}$ d. nearly; or more accurately, 1l. sterling = 48 reals, 20 $\frac{3}{4}$ Maravedis of old plate, or 91 reals 17 Maravedis vellon.

By the reports of average assays lately made on the quadruple and dollar at the London mint by order of the bank of England, the quadruple weighs 17 dwt. 8 gr.; its fineness 4 $\frac{1}{2}$ gr. worse than English standard: hence its value in English gold coin is 3l. 4s. 0 $\frac{1}{2}$ d. The dollar weighs 17 dwt. 8 gr.; its fineness 8 dwt. worse than English standard: hence its value in English silver coin is 4s. 3 $\frac{3}{4}$ d. See PISTOLE.

The value of reals of Spain, and monies of account, expressed in pence and decimals of pence, according to the mint price both of gold and silver in England, i.e. 3l. 17s. 10 $\frac{1}{2}$ d. per ounce for gold, and 5s. 2d. per ounce for silver, is as follows:

	Value in Silver.	Value in Gold.
	d.	d.
Real of old plate - - -	4.93	4.57
Real of new plate - - -	5.24	4.86
Real of Mexican plate - - -	6.55	6.07
Real vellon - - -	2.62	2.43
The dollar of old plate, or of exchange - - -	39.45	36.59

The assay, weight, &c. of Spanish silver coins compared with the English standard of 11 oz. 2 dwt., and according to the mint price of silver in England, i.e. 5s. 2d. per ounce standard, are as follow, W. denoting worse than English standard.

	Assay.	Weight.	Contents in Pure Silver.	Value in Sterling.
	oz. dwt.	oz. dwt. gr.	grains.	s. d.
Dollar, old Mexican square (1747) - - -	W. 0 4 $\frac{1}{2}$	0 17 7	376.1	4 4 $\frac{1}{2}$
Half ditto - - -	W. 0 4 $\frac{1}{2}$	0 8 15 $\frac{1}{2}$	188.	2 2 $\frac{3}{4}$
Dollar, old, called Sevillian (1731) - - -	W. 0 4 $\frac{1}{2}$	0 17 7	376.1	4 4 $\frac{1}{2}$
Old Mexican peceta, of two Mexican reals (1734) - - -	W. 0 4 $\frac{1}{2}$	0 4 7 $\frac{1}{4}$	93.6	1 1
Real of Mexican plate (1746) - - -	W. 0 4 $\frac{1}{2}$	0 2 3 $\frac{1}{2}$	46.8	0 6 $\frac{1}{2}$
Dollar, Mexican, with globes and pillars (1765) - - -	W. 0 4 $\frac{1}{2}$	0 17 8 $\frac{1}{2}$	377.	4 4 $\frac{1}{2}$
Peceta, of two reals of plate (1721) - - -	W. 1 7	0 3 16 $\frac{1}{2}$	71.9	0 10
Real of plate (1721) - - -	W. 1 7	0 1 20 $\frac{1}{4}$	35.9	0 5
Dollar, of late coinage, universally circulated under the name of the Spanish dollar - - -	W. 0 8	0 17 8	370.9	4 3 $\frac{3}{4}$
Half dollar, ditto - - -	W. 0 8	0 8 16	185.2	2 1 $\frac{3}{4}$
Mexican peceta (1774) - - -	W. 0 8	0 4 7 $\frac{1}{2}$	92.3	1 0 $\frac{3}{4}$
Real of Mexican plate (1775) - - -	W. 0 8	0 2 3 $\frac{1}{4}$	46.1	0 6 $\frac{1}{4}$
Peceta provincial, of two reals of new plate (1775) - - -	W. 1 9 $\frac{1}{2}$	0 3 18	72.2	0 10
Real of new plate (1795) - - -	W. 1 9 $\frac{1}{2}$	0 1 21	36.1	0 5

For the assay, weight, value, &c. of gold coins, see PISTOLE.

REAL, or *Realì*, is also a money of account at Leghorn. At Zante, and also Cefalonia and Corfu, accounts are kept in reali, of 10 lire, or 100 foldi, also called aspri.

REAL is the name of a kind of boat in some places.

REAL *el Novita*, in *Geography*. See NOVITA.

REAL *Nuevo*, a town of Mexico, in the province of New Buicay; 120 miles N.W. of Parral. N. lat. 29° 10'. W. long. 107° 20'.

REAL del Rosario, a town of Mexico, in the province of Chiametlan, on the Spiritu Santo; 24 miles N. of Chiametlan.

REAL de Frayles, a town of New Mexico, in the province of Mayo; 60 miles from Santa Cruz. N. lat. $27^{\circ}44'$. W. long. $110^{\circ}22'$.

REAL de Minas, a town of New Navarre; 180 miles S.S.E. of Casa Grande.

REAL de St. Juan, a town of New Navarre; 195 miles S.S.E. of Casa Grande.

REAL de la Jura, El, a town of Spain, in the province of Seville; 25 miles N.W. of Carmona.

REALE, *Knights of the, or Knights of the Lions*, owed their institution to the following event. Ladislaus, son of Charles Duras, having been proclaimed and crowned king of Naples at Gaeta, the Neapolitans set up Lewis II. duke of Anjou, and laid the foundation of the bloody wars that followed. These troubles divided the Neapolitan nobles into two factions; and of those who declared for the house of Anjou, some wore on their left arm a golden *reale* embroidered or on a red ground, by way of contempt to queen Margaret, widow of Charles III. who wanted to hold the reins of government during the minority of Ladislaus, and called themselves "knights of the Reale;" whilst others wore on their breast the figure of a "lionsess, with her feet tied," pendant to a ribbon which passed round their necks, indicating by it, that they looked upon queen Margaret as tied by the leg; and then styled themselves "knights of the Lionsess."

REALEJO, in *Geography*, a town of Mexico, in the province of Nicaragua, situated on a bay of the Pacific ocean, at the mouth of a river, both of the same name. The river is so deep and capacious as to be capable of receiving 200 sail of ships. The town is defended by large intrenchments, and very fine docks for building and repairing ships; but the place suffered considerably from the Buccaneers. The town is large, has three churches, and an hospital; but the place is unhealthy, on account of the creeks and stinking swamps in its vicinity. Its chief trade consists in pitch, tar, and cordage. At the mouth of the harbour is an island, which intercepts the sea, and renders it safe and commodious: it forms two channels, but that on the N.W. side is much the best; 18 miles N.W. of Leon. N. lat. $12^{\circ}45'$. W. long. $87^{\circ}30'$.

REALGAR, in *Mineralogy*, sometimes called red orpiment, an ore of arsenic, consisting, according to Thenard, of
75 parts arsenic,
25 sulphur.

The colour of realgar is a bright deep red, passing into scarlet and orange: it occurs both massive, and crystallized in prisms, which have either 4, 6, 8, 10, or 12 sides, terminated by four-sided summits. The primitive form of the crystal is an octahedron, with scalene triangles. The lustre of realgar is between vitreous and waxy: it is semi-pellucid, soft, fragile, and easily fusible, burning in the air with a blue flame, and giving out arsenical and sulphureous vapours. By friction it becomes negatively electrical. Realgar is found in the vicinity of volcanos, and accompanying other metallic ores, both in primitive and secondary mountains. This substance is used as a pigment; and is formed by the Chinese into toys. See *Sulphurated Arsenic* under **ARSENIC**.

In the history of the French Academy, we have an account of a cup brought to Paris by the ambassadors of Siam, and presented there, as a remedy used by that people against all diseases.

Upon an examination, which had like to have cost M. Homberg dear, he found it to be a kind of realgar, or red arsenic, much more caustic than ours.

Its use among the Siamese, he takes to have been the same with that of regulus of antimony; viz. to give an emetic quality to the wine drank out of it.

As the dose of medicines is much stronger in the torrid zone than among us (the quantity of ipecacuanha, *e. gr.* ordinarily taken by the Indians, being twenty times as great as that among us), it is very possible a cup of realgar, though enough to poison an European, may prove a gentle medicine to a Siamese.

REALIJO, in *Geography*, a small island in the Pacific ocean, near the coast of Popayan. N. lat. $4^{\circ}16'$.

REALIZE, in *Commerce*, a term little known in trade before the year 1719, when those immense fortunes began to be made in France and England, by the business of actions or stock.

By *realizing* is meant the precaution many of those who had gained most, took, to convert their paper into real effects: as lands, houses, rich moveables, jewels, plate; but, above all, into current species. A precaution capable of ruining the state; but the French regency had the wisdom to frustrate it, by taking proper measures to have the money, thus ready to be hoarded up, returned to the public.

REALISTS, **REALISTÆ**, a sect of school-philosophers who followed the doctrine of Aristotle with respect to universal ideas, formed in opposition to the **NOMINALISTS**, (see that article,) who embraced the hypothesis of Zeno and the Stoics upon that perplexed and intricate subject.

Aristotle held, against Plato, that, previous to, and independent on, matter, there were no universal ideas or essences, and that the ideas or exemplars which the latter supposed to have existed in the divine Mind, and to have been the models of all created things, had been eternally impressed upon matter, and were coeval with, and inherent in, their objects. Zeno and his followers, departing both from the Platonic and Aristotelian systems, maintained, that these pretended universals had neither form nor essence, and were no more than mere terms and nominal representations of their particular objects.

Under the Realists are included the Scotists, Thomists, and all excepting the followers of Occam.

Their distinguishing tenet is, that universals are realities, and have an actual existence, out of an idea and an imagination; or, as they express it in the school-language, *a parte rei*; whereas the Nominalists contend, that they exist only in the mind, and are only ideas, or manners of conceiving things.

Doctor Odo, or Oudard, a native of Orleans, afterwards abbot of St. Martin de Tournay, was the chief of the sect of the Realists. He wrote three books of dialectics; where, on the principles of Boethius and the ancients, he maintained that the object of that art is things, not words; whence the sect took its rise and name.

REALITY, **REALITAS**, in the *Schools*, a diminutive of *res*, *thing*, first used by the Scotists to denote a thing which may exist of itself, or which has a full and absolute being of itself, and is not considered as a part of any other.

Yet a reality is conceived as something less than *res*; and accordingly every *res* is supposed to contain a number of realities, which they otherwise call *formalities*.

Thus, *e. gr.* in a man, according to the doctrine of the Scotists, are a number of realities; viz. a substance, life, animal, and reason.

Some

Some distinguish reality into subjective and objective.

REALM, REGNUM, *Kingdom*, a country which gives its head or governor the denomination of king.

The word is formed of the French *royaume*, which denotes the fame.

REALMONT, in *Geography*, a town of France, in the department of the Tarn, and chief place of a canton, in the district of Alby; 9 miles S. of Alby. The place contains 2247, and the canton 8949 inhabitants, on a territory of 247½ kilometres, in 19 communes.

REALVILLE, a town of France, in the department of the Lot; 8 miles N.E. of Montauban. N. lat. 44° 6'. E. long. 1° 34'.

REAMIA, a town of the Arabian Irak; 10 miles W. of Bassora.

REAMO, a town of Naples, in Abruzzo Ultra; 6 miles W.N.W. of Teramo.

REAMUR, a town of France, in the department of the Vendée; 18 miles N. of Fontenay le Comte.

REANG, a town of Bengal; 45 miles S. of Silhet.

REAPER, a person whose business it is to reap or cut grain.

REAPING, the operation of cutting crops by means of the sickle. It is a very laborious sort of field-work, and one which requires considerable attention and care to perform it in a neat and exact manner. Reaping is performed with some other sorts of crops, besides those of the grain kinds; as occasionally for peas, beans, flax, and others of a similar nature. Work of this nature is executed in many different ways, according to the differences in the customs of different districts; as by sets of men hired by the month, for this particular purpose, called harvest-men; by persons taking it by the piece, or by the acre, and by the sheaf or stook of eight sheaves.

In some methods, by the piece or the quantity is unquestionably the best, in most cases, on account of the very high prices which are exacted at this very busy season, and the very small extent of labour which is performed in working by the day, which cannot be controlled by the farmer at such hurrying times. Besides, the work is, for the most part, the best and most expeditiously performed in these ways; which are objects of very great importance, and deserving of much consideration in this sort of business. The eye of the farmer is, however, constantly necessary to see that all goes on in a right manner.

In the northern parts of Lancashire, this sort of labour is mostly performed by the day, or the haddock of ten sheaves, or the stook of twelve sheaves; three-pence being often paid for the former, and four-pence or five-pence for the latter, in these places.

In some districts, the reaping of the crops commences before they are quite ripe; but in others, not until this has fully taken place.

REAPING of *Corn*, the practice of cutting it with the sickle, or otherwise, by persons employed for the purpose. It may be observed, that the business of reaping or cutting grain crops differs much in the manner of performing the work, in different districts of the kingdom, and kinds of crops. In the more southern parts of the island, the crops of this sort are mostly cut by means of short stiff scythes, made for the purpose, having bows formed of bent sticks, or what in some places are termed *cradles*, fixed upon the lower parts of the handles, for the more readily depositing the ears or heads of the corn in one uniform direction, as much as possible, in order that it may be afterwards bound up into sheaves. But in other cases, the naked scythe is

made use of; the corn being seldom bound up, being simply raked together into small heaps, in a similar manner to hay.

In the more northern parts of England, and in Scotland, the reaping of grain crops is, however, in general performed by the sickle, or reaping hook; the different handfuls, as soon as cut, being deposited upon bands, formed by twisting together a few stalks of the corn at the ends next the ears, and afterwards bound up into sheaves, in order to their being set up into *shocks* or *hattocks*. This method is, in most instances, adopted with the wheat and rye crops, in every part of the island; as in cutting them with the scythe, it is difficult to be performed without much loss being sustained by the shedding of the grain. And, in addition, it is of great advantage to have these sorts of crops bound up regularly into sheaves, the straw being much better.

Besides these, there is another mode sometimes practised, which is by means of a hook with a sharp edge, without any teeth; the labourer, in executing the work, hooking up the corn towards him. It is mostly made use of in the southern districts, where it is known by the name of *bagging*, the grain in this way being cut very low.

In this way the reaper collects enough for one sheaf at a time, binds it, and sets it up in tens, called a shock in Middlesex. This *bagging* (or *fagging*) practice is, to all intents and purposes, mowing with one hand against the standing corn. The toothless hook, employed in doing it, is of nearly twice the weight of the common sickle. It is sharpened occasionally, when necessary, in the manner of the scythe; and the operation of cutting the crop down is by a succession of blows made upon the straw of the standing grain, very nearly in the direction down towards the surface of the ground. Reaping in Middlesex is mostly all done in this way, as the proper use of the scythe is but little known.

This method has the advantage of being done closer, and with equal or more expedition than the hand reaping mode, besides the saving in straw, which is here supposed worth 7s. the acre.

In Essex wheat crops are generally reaped or cut with the sickle, though in the vicinity of the metropolis it is not uncommon to have it mown with the scythe, as close to the ground as other sorts of grain crops, in the view of increasing the quantity of straw, which is there very valuable. It is thrown, in these cases, with great skill and dexterity into fwaths. When perfectly ripe, it is soon bound up into sheaves of six or eight inches diameter, with bands of wheat-straw of single or double lengths; but when not in this ripe or dry state, it is allowed to remain in the fwaths two or three days, as necessary. However, in more than three quarters of the county, it is reaped or cut with the sickle; and indeed in almost all places, when beaten down by the wind and rain.

In regard to the time of reaping the grain, there is considerable difference in different districts; some not reaping it until it is quite ripe, while others cut it when something short of this state. This, however, should probably be regulated by the nature of the season, and the kind state or quality of the crop, as well as the uses to which the grain is to be put.

In respect to the manner of reaping grain crops, whether the sickle or scythe be employed for the purpose, there is much difference in the height at which the crops are cut in different places. In some it is the practice to have the business performed in as close a manner as possible; while in others a stubble of eight, ten, and fifteen inches, or more,

is left. These different practices have their advocates; one party supposing that the work proceeds more slowly, where it is executed in so close a manner; while the other contend that the contrary is the case. But as the stubble which is left is not only useless to the land, but in many cases very troublesome in its succeeding culture, being frequently under the necessity of being removed, it would seem to be the best as well as cheapest practice, to have the business constantly executed in a close manner. It has been observed by a late practical writer, that by this means the agricultor will not only have more litter at command, for the bedding of his yards, stalls, and other places, and consequently an increase of manure, but have the business more expeditiously performed, with much less waste of grain, and at the same time be freed from the trouble and expence of removing the stubble. It has indeed been fully shewn, by a careful trial, made with the view of ascertaining the difference between high and low reaping, that the advantage is considerably in favour of the close method.

And the result of the trial is thus stated by the writer of the Agricultural Survey of the West Riding of Yorkshire, who observes that the experiment was made upon part of a field of wheat, two ridges of which were cut close by the ground, and the other two considerably higher, though not so high as the general run of the Yorkshire stubbles. Each of the divisions was apparently of equal quality, and measured a trifle more than a quarter of a Scotch acre, which is about one-fifth larger than the English statute acre. The crop was stacked separately, and the time taken to the part cut low was one hour and twenty-four minutes, of eight shearers; while the high cutting was performed by the same number of hands in forty-eight minutes. The wages paid that week were 18*d.* per day, and the supposed expence of maintenance 6*d.* or 2*s.* per day altogether. When threshed, the grain and straw were carefully measured and weighed, and the result of the experiment was as follows:

	£	s.	d.
Result—8 shearers, 1 hour 24 minutes, at 2 <i>s.</i> } per day, or 22½ <i>d.</i> per hour - - - }	0	2	4
The same hands in 48 minutes - - - }	0	1	4
Difference of expence	0	1	0

In favour of high cutting one shilling, or four shillings^a per acre.

	£	s.	d.
1¼ peck of wheat more upon the low cut } ridges than those cut high, at 1 <i>s.</i> 4 <i>d.</i> per } peck - - - - - }	0	1	8
14 stones (22 avoirdupois pounds) of more } straw, at 2 <i>d.</i> per stone - - - - }	0	2	4
	0	4	0

Or sixteen shillings per Scotch acre.

From which deduct the increased expence of cutting, there remains a benefit of twelve shillings per acre in favour of low cutting.

It is noticed farther, that the above trial, according to the best of the reporter's judgment, was fairly made; and the reason which urged him to make it, was to silence the objections of some neighbours, who alleged low shearing was not profitable. It is also proper to observe, that the field of wheat, on which the trial was made, was not broke down nor straggled, so was in a favourable condition for high cutting. We have seen wheat-fields, where three times

the quantity might have been left, unless great pains were used.

But the methods of reaping grain crops, both with the sickle and the scythe, have each their advantages and disadvantages. In the first manner, the crops are deposited with more regularity and exactness, and consequently bound into sheaves with greater facility and dispatch. Besides, in many cases less loss is incurred by shedding, in the time the work is in performing; but the labour is executed with greater difficulty and trouble. The latter possesses the superiority of being more expeditious, and of being performed to any degree of closeness that may be required; while it has the evident disadvantage of leaving the cut grain in a more irregular and uneven situation, by which it is rendered less fit for being bound up into sheaves, which in many cases is an inconvenience of great consequence. When the grain has attained a high degree of ripeness, there may likewise be great loss sustained, by its being shed during the operation, in this way of reaping and cutting the crop. Where this method is practised, it is, however, not unfrequently the case to have it bound into sheaves; though the most common custom is to let it remain in the rows or swathes, till fit for being put into the stack. When bound, it is generally the practice to cut it inwards against the crop on which it rests: in the other case, it is cut in the manner of grafs for hay. It is obvious, therefore, that when labourers are procured with difficulty, this mode of reaping is the most adviseable; while, under the contrary circumstances, the former may be had recourse to with more advantage, as the work may be executed in a neater and more exact way. See HARVESTING and SICKLE.

It may be remarked, that this is a sort of work that is often let by the acre to persons that go about for harvest work; and it may, in many cases, be the best performed in this manner. But great attention should be paid by the farmer, to see that the grain is cut and bound up in a proper method, and that the work be not performed in improper weather. The prices vary according to the nature of the crops, the season, and other circumstances, sometimes rising as high as eleven or twelve shillings the acre, and sometimes much higher.

REAPING Fork, a tool of the fork kind, invented for the purpose of raising and collecting the mown grain into sheaves, so that it may be bound up. It is constructed with two, rather long, prongs below, slightly curving upward, somewhat in the manner of the common large hay fork, to which are attached, at the upper part, near the insertion into the handle, two other upright prongs, which bend a little forward towards their tops or ends; by means of which, with the under prongs running along the ground, the tool being pushed forward by the labourer, the grain in the straw is raised up, brought together, held in a firm manner, and removed from the swathe so as to be bound into sheaves. In this way, the lower prongs perform the work of picking the strawy material from the land, while the higher upright ones prevent it from falling backwards, and determine the quantity which is necessary for a sheaf. In this manner, by this simple contrivance, the mown grain can be brought together and bound up with much greater regularity, and in a much more expeditious method than is possible to be done by mere hand labour.

REAPING Hook, an implement of the sickle kind, with which the business of reaping is performed in some districts.

These hooks are sometimes formed with teeth, or in a toothed manner, and sometimes with a cutting edge. In Devonshire, and some other counties, those with smooth edges are generally preferred to sickles with sawed ones: these

these sorts of hooks are used occasionally with either hand, the operator shifting hands, chopping the straw low down, and gathering about half a sheaf at a time, which, when put together, is bound with reed, combed from former wheat-straw, or with a double length of the wheat which is reaping. See *SICKLE*.

REAPING Machine, a contrivance for the purpose of reaping grain by means of animal labour. With this view, and to facilitate an operation of such importance to the farmer, different attempts have been made to construct machines, so as to dispatch the work in a rapid manner by the assistance of horse labour, but the success with which they have been attended, has hitherto been far from complete. An implement of this sort has lately been made by Mr. Plunknett; it is upon a somewhat new principle, the horse drawing the machine instead of pushing it forward, as was the old mode of applying the power.

In this machine, the horse tracks from the front side of it, which is seen at once by the appearance of the implement, so as to be clear of the crop, and the two large wheels, by means of the axle, drive another wheel, which communicates with the two other wheels, the latter of which is found in the axis of the cutter: a man at the handles regulates the direction, &c. This machine may be seen fully represented in the second volume of the *Farmer's Dictionary*; and a reaping machine for clover may be seen in the same work in the same plate.

Other machines of this kind have still more lately been invented by other persons, but without answering the purpose in that full and complete manner which is necessary in this sort of work.

What appears to be chiefly wanting in these sorts of machines, to render them complete and effective, as tools for the purpose of reaping, is that of their having more power or velocity in the cutting parts, so that the work may be performed in a perfectly clean neat manner, without the straw being drove or forced down in an improper manner before the instruments which are to cut it; their cutting it out fully in the whole of its breadth; their being capable of being regulated to cut at different heights, and to different breadths; their being made capable of directing the cut strawy grain all in one even regular direction, so that it may be bound up with facility; the horses, or other animals, being so attached to them as to permit of their walking along on the side of the standing grain, where the former cut was made, or where they pull the implements before them, the having them so conveniently fixed in them as to admit of no sort of interruption to the labour in any way; their being made light and of ready application, as well as at a cheap rate; and their keeping the scythes or cutting parts in a perfectly sharp state, without their being taken out, and undergoing the operation of whetting. There are, besides these, some other points, which should be attended to, but these are, probably, the most material.

REAPS, small parcels of corn, laid along on the stubble, in reaping, to be afterwards gathered into sheaves by the binder. This is most commonly the case, when the weather is moist, as in dry times the reaps of corn are usually laid in the bands, and tied up, as soon as they are in sufficient quantity, into sheaves.

REAR, a term frequently used in composition, to denote something behind or backward in respect of another; in opposition to *van*, or *avant*, before.

It is formed by corruption of the French *arriere*, signifying the same.

REAR, in a *Military Sense*, is used for the hind-part of an army, &c. in opposition to the *front*, or face of it.

REAR, in *Naval Language*, is a name given to the last division of a squadron, or the last squadron of a fleet, and which is accordingly commanded by a rear-admiral, or the third officer of the said fleet or squadron.

REAR-admiral. See *ADMIRAL*.

REAR-guard. See *GUARD*.

REAR-half-files, are the three hindmost ranks of a battalion, when it is drawn up six deep. See *FILE-leaders*.

REAR-line of an army encamped, is always twelve hundred feet at least from the centre line, both of which run parallel to the front line, and also to the reserve.

REAR-rank, is the last rank of a battalion, or squadron, when drawn up, and generally sixteen or eighteen feet from the centre line, when drawn up in open order.

REAR-up, in the *Manege*, called in French *cabrer*, is the action of a horse, when he raises himself upon his houghs or hinder legs, as if he would fall quite over in a backward direction, to the great danger of his rider. This is often caused by his having too much of the curb.

REAR, in *Rural Economy*, to raise the roof part of any sort of shed or other building for containing some kind of live-stock.

REARED, or *Wale-REARED*. See *WALE-reared*.

REARING ANIMALS, in *Agriculture* and *Rural Economy*, the business of breeding and bringing them up to the most suitable states for the purposes of the farmer. The principles of this art depend upon a variety of different circumstances and kinds of knowledge, as has been already explained. See *BREEDING*, and *LIVE-Stock*.

Animals of the horse kind should invariably be brought up in the best manner, without any sort of flinting in their food, according to the uses they are designed to serve, in order that they may have their full growth and power. In the labouring cattle kinds of animals, attention should, in some degree, be paid to hardiness, both in their food and their exposure, by having recourse to the more coarse sorts of feeding in the less sheltered situations, but nothing of flinting should ever be allowed, as by these means they become large, and capable of sustaining a greater degree of exertion. There is, likewise, much utility in good training, in rearing all sorts of animals in this intention; and it requires careful, steady, mild persons to be employed in it, as they, for the most part, acquire the habits and dispositions of those about them, in some measure; and the more early they are obtained the better. This point deserves much more attention from farmers and others than it has hitherto met with, as most of the bad habits of working animals arise from the neglect of it. Besides, good training and mild dispositions are highly favourable to fattening animals. See *HORSE*.

In rearing poultry, pigeons, rabbits, and fish, much care, management, and circumspection, are constantly necessary, in order to their perfect success. Too little attention is for the most part bestowed on the nature of the birds, in some sorts of the more wild poultry kinds, as those which are of the game description, for instance, the galena, the pheasant, the swan, and some others. These cannot be so readily reared, or with so much facility, under hens of the domestic kind, as other sorts are, such as the turkey, peacock, &c. This circumstance should therefore be always kept in mind in rearing such birds. See *POULTRY*, *PIGEONS*, *RABBIT*, &c.

A very nice attention and management is also requisite in the rearing and perfecting of fish. See *FISH*, *POND-Fisheries*, and *Salmon FISHERY*.

In rearing birds of the game kind, such as the above, in the way of ornament about a residence, Mr. Loudon has remarked, much depends upon encouraging them, when allowed

lowed to go wild, by giving them proper and abundant cover, and sowing among it such herbs and plants as they are particularly fond of, as those of the cress, chervil, parsley, thyme, and some other kinds. They have likewise a tendency to encourage and domesticate hares. Abundance of fearless game about a residence, he thinks, give a peculiar nobleness, and appearance of freedom, which few things else can communicate or afford.

REASON, *RATIO*, a faculty or power of the soul, by which it distinguishes good from evil, and truth from falsehood. Or, reason is that principle, by which, comparing several ideas together, we draw consequences from the relations they are found to have.

Some of the later school-philosophers define reason to be the comprehension of many principles which the mind successively can conceive and from which conclusions may be drawn.

Others conceive reason as no other than the understanding itself, considered as it discourses.

Reason, Mr. Locke observes, comprehends two distinct faculties of the mind; *viz. sagacity*, by which it finds intermediate ideas; and *illation*, by which it so orders and disposes of them, as to discover what connection there is in each link of the chain, by which the extremes are held together; and by them, as it were, draws into view the truth fought for.

Illation, or inference, consists in nothing but the perception of the connection there is between the ideas in each step of the deduction, by which the mind comes to see either the certain agreement or disagreement of any two ideas; as in demonstration, in which it arrives at knowledge; or their probable connection, on which it gives or withholds its assent; as in opinion.

Sense and intuition reach but a little way; the greatest part of our knowledge depends upon deductions, and intermediate ideas. In those cases, where we must take propositions for true, without being certain of their being so, we have need to find out, examine, and compare, the grounds of their probability; in both cases, the faculty which finds out the means, and rightly applies them to discover certainty in the one, and probability in the other, is that which we call *reason*.

In reason, therefore, we may consider four degrees; first, the discovering and finding out of proofs. See *INVENTION*.

Secondly, the regular and methodical disposition of them, and laying them in such order, as that their connection may be plainly perceived. See *METHOD*.

Thirdly, the perceiving of their connection (see *JUDGMENT*.) And,

Fourthly, the making a right conclusion.

Reason fails us in several instances; as, first, where our ideas fail.

Secondly, it is often at a loss, because of the obscurity, confusion, or imperfection, of the ideas it is employed about. Thus, having no perfect idea of the least extension of matter, nor of *infinity*, we are at a loss about the divisibility of matter.

Thirdly, our reason is often at a stand, because it perceives not those ideas which would serve to shew the certain or probable agreement or disagreement of any two other ideas.

Fourthly, our reason is often engaged in absurdities and difficulties, by proceeding upon false principles, which, being followed, lead men into contradictions to themselves, and inconsistency in their own thoughts.

Fifthly, dubious words, and uncertain signs, often puzzle men's reason, and bring them to a nonplus.

Though the deducing one proposition from another be a great part of the office of reason, and that about which it is usually employed; yet the principal act of ratiocination is the finding the agreement or disagreement of two ideas one with another, by the intervention of a third. As a man, by a yard, finds two houses to be of the same length, which could not be brought together to measure their equality by juxtaposition. Words have their consequences as the signs of such ideas and things agree or disagree with what they really are; but we observe it only by our ideas.

Hence we may be able to form an idea of that ordinary distinction of things, into such as are *according to*, those that are *above*, and those *contrary to reason*.

Those *according to reason* are such propositions, whose truth we can discover by examining and tracing those ideas we have from sensation and reflection, and by natural deduction find to be true or probable.

Those *above reason* are such propositions, whose truth or probability we cannot by reason derive from those principles.

Those *contrary to reason* are such propositions as are inconsistent with, or irreconcilable to, our clear and distinct ideas.

Thus the existence of one God, is according to reason; the existence of more than one God, is contrary to reason; and the resurrection of the body after death, above reason.

Above reason may be also taken in a double sense; *viz.* above probability or above certainty.

They who dispute most against the power and privileges of human reason, do it because their own reason persuades them to that belief; and so, whether the victory be on their or our side, they are equally defeated.

They seek to terrify us with the example of many great wits, who, by following this *ignis fatuus* (so they call the only pole-star God has given us to direct our course by), have fallen into wild and ridiculous opinions, and increased the catalogue of heresies to so great a number; but these men either followed not their reason, but made it follow their will; or else they first hoodwinked it by interest and prejudice, and then bade it shew them the way; or were wanting in those necessary diligences required for so doubtful a passage: or if, without any of these, the weakness of their understanding had deceived them, the error is neither hurtful to themselves, nor would be to others, if this doctrine of governing ourselves by our own reason, and not by authority and example, were generally established. *Dis. Concern. Hum. Reas.*

It is not the use of such liberty, but the appropriating it to ourselves, that is the cause of all the disorders charged upon it; for those who lay a restraint on other men's reason, have first made use of their own to settle them, and to make use of it in this very restraining of others. *Ibid.*

REASON, in *Matters of Religion*, is used in opposition to *faith*.

This use of the word, Mr. Locke takes to be in itself very improper; for faith is nothing but a firm assent of the mind; which, if it be regulated, as it is our duty, cannot be afforded to any thing but upon good reason, and so cannot be opposite to it.

He that believes without having any reason for believing, may be in love with his own fancies; but he neither seeks truth as he ought, nor pays the proper obedience due to his Maker, who would have him use those discerning faculties he has given him, to keep him out of mistake and error.

But since reason and faith are by some men opposed to one another, it may be necessary to consider them together.

Reason, as contradistinguished to faith, is the discovery of the certainty or probability of such propositions, or truths, which it has got by the use of its natural faculties; *viz.* by sensation, or reflection.

Faith, on the other hand, is the assent to any proposition upon the credit of the proposer, as coming immediately from God; which we call *revelation*, which see.

REASON, in *Logic* and *Rhetoric*, denotes a necessary or probable argument; or an answer to the question, *cur est? why is it?*

As if it be inquired, why do the subject and predicate agree? and it is answered, because they are spoken of the same thing: this last enunciation is a reason. Hence, say the schoolmen, because *quia* is the sign or character of a reason, as *non*, *no*, of a negation, and *est*, *is*, of an affirmation.

They make three kinds of reasons, *rationes*; *viz.* *ratio ut*, *that*; *ne*, *lest*; and *quia*, *because*. For, answering to a question, *cur*, *why*, we begin with *because*, *quia*; as, why do you study? that I may become learned; which is the *ratio ut*. Again, why do you study? lest I should be ignorant; which is the *ratio ne*. Lastly, why is a body tangible? because matter is impenetrable; which is the *ratio quia*.

The *reason ut* properly denotes the end, or final cause; and *reason ne* the beginning: accordingly the one is called the beginning, the other end; so that the *reason quia* is left the only reason, properly so called.

REASON, among *Metaphysicians*, is used in the same sense with *essence*; or that by which any thing is what it is.

This is sometimes also called formal reason, as representing the thing under that form or nature under which it is conceived.

REASON, in *Mathematics*. See *RATIO*.

Reason of State, *Ratio Status*, in *Matters of Policy*, denotes a rule or maxim, whether it be good or evil, which may be of service to the state.

The phrase is borrowed from the Italians, who first used *ragione di stato* in this sense.

Reason of state is properly understood of something that is necessary and expedient for the interest of the government, but contrary to moral honesty, or justice.

Politicians have a long time disputed about the *ratio status*; whether states and governments are tied down to the same laws of morality with individual persons; or whether things, otherwise immoral and unlawful, may not be practised on urgent occasions, by way of reason of state?

The question is, whether any thing be unlawful, or prohibited a state, that is necessary to the preservation of that state, or whether it be allowed to preserve itself on any terms?

REASON, *Challenge upon*. See *CHALLENGE*.

REASON sufficient of Leibnitz. See *LEIBNITZIAN Philosophy*.

REASONABLE AID, a duty which the lord of the fee anciently claimed of his tenants, holding in knight's service, or on socage, towards the marrying his daughter, or the making his eldest son knight.

This is taken away by stat. 2 Car. II. See *AID*.

REASONING, *RATIOCINATION*, the exercise of that faculty of the mind called *reason*: or, it is reason deduced into *discourse*; which see.

The agreement or disagreement of two ideas does not appear from the bare consideration of the ideas themselves, unless some third be called in, and compared, either sepa-

ately, or conjointly with it: the act, then, by which, from ideas thus disposed and compared, we judge this or that to be so, or not so, is called *reasoning*. Or, it is that operation of the mind, by which we infer one thing, *i. e.* one proposition from two or more propositions premised. Or, again, it is the drawing of a conclusion, which before was either unknown, or dark, or doubtful, from some propositions which are more known and evident. It is the narrowness of the human mind which introduces the necessity of reasoning; for if the mere perception and comparison of two ideas would always shew us whether they agree or disagree, then all rational propositions would be matters of intelligence, or first principles, and there would be no use of reasoning, or drawing any consequences. But when we are unable to judge of the truth or falsehood of a proposition in an immediate manner, by the mere contemplation of its subject and predicate, we are then constrained to use a medium, and to compare each of them with some third idea, that by seeing how far they agree or disagree with it, we may be able to judge how far they agree or disagree among themselves. Watt's *Logic*, part iii. chap. 1.

Robault defines reasoning to be a judgment depending on some antecedent judgment: thus, having judged that no even number can be composed of five uneven numbers, and that ten is an even number; to conclude, that ten cannot be divided into five uneven parts, is a ratiocination, or reasoning.

This agrees with father Malebranche's doctrine, one of the great points of which is, that reasoning, on the part of the understanding, is only a mere perceiving.

That ingenious author endeavours to shew, that, as to the understanding, there is no difference between a simple perception, a judgment, and a reasoning, except in this, that the understanding perceives a simple thing without any relation to any thing else, by a simple perception; that it perceives the relations between two or more things in a judgment; and, lastly, that it perceives the relations that are between the relations of things, in a reasoning. So that all the operations of the understanding are no more than mere perceptions.

Thus, *e. gr.* when we conclude, that 4 being less than 6, twice 2 being equal to 4, are of consequence less than 6, we do no more than perceive the relation of the inequality between the relation of twice 2 and 4, and the relation of 4 and 6.

The manner of proceeding justly in reasoning; so as to arrive with the greater safety at the knowledge of truth, makes what we call *method*.

For the real benefit of logic to reasoning, see *LOGIC* and *SYLLOGISM*.

RE-ATTACHMENT, in *Law*, a second attachment of him who was formerly attached, and dismissed the court without day, by not coming of the justices, or the like casualty.

Brook makes re-attachment either *general* or *special*. *General* is where a man is re-attached for his appearance on all writs of assize lying against him: *special*, for one or more certain writs.

REAU, in *Geography*, a town of Germany, in the principality of Culmbach; 9 miles S.E. of Hof.

REAVE, in *Rural Economy*, a provincial term, used to signify the unroofing or disturbing the thatch or other covering of a building by winds, &c.

REAUMUR, RENÉ-ANTOINE FERCHAULT, *Sieur de*, in *Biography*, was born in 1683 at Rochelle. He was brought up to the study of the law, which he quitted for that

that of the mathematics, natural history, and natural philosophy. In 1703 he went to Paris, and so distinguished himself in a few years, that in 1708 he was admitted into the Academy of Sciences. From that time he entirely gave himself up to the pursuits of natural history in all its branches, and few men have passed a life more actively and usefully employed. Utility was the constant aim in all his enquiries, even into the most minute parts of nature; and experiment and observation were his perpetual guides. No one surpassed him in the patient industry with which he observed natural phenomena, or followed the processes of art. The Memoirs of the Academy of Sciences, from 1709 to 1756, are enriched with his communications. The improvement of manufactures was a great object of his attention. In 1722 he published a work, entitled "*L'Art de convertir le Fer forgé en Acier, et l'Art d'adoucir le Fer fondu*," which contained a minute and scientific account of the processes employed in that branch of manufacture, with hints for their improvement. He introduced into France the manufacture of tinned iron, which article had before been imported from abroad; and he made a great many experiments in the manufacture of porcelain, which contributed to its perfection in France. He also performed numerous experiments relative to the art of hatching chickens by artificial heat, as practised in Egypt, an account of which he published in two vols. 1752. M. Reaumur rendered his name celebrated by his peculiar method of graduation on the thermometer, which is still the only one used in France and many parts of the continent. In this thermometer the freezing point is marked zero, and the boiling point at 80°. (See THERMOMETER.) Some of the most valuable of Reaumur's physiological experiments were those relating to the concoctive powers of the stomach in granivorous and carnivorous birds, in which he clearly establishes the different modes of action in these two classes, viz. by trituration, and by solution. In natural history, he acquired the greatest fame as an entomologist. Besides a number of curious papers on this subject in the Memoirs of the Academy, he published a very elaborate work, entitled "*Memoires pour servir à l'Histoire Naturelle des Insectes*," in six vols. 4to. 1734—1742. This work was the labour of many years, and the result of innumerable observations made in his garden, in which he kept insects of all kinds, that he might examine their generation, changes, and mode of life. Reaumur was a man of much private worth, of mild and amiable manners, and correct morals. He died in 1757, at the age of 75. He bequeathed his manuscripts, and cabinet of natural philosophy, to the Academy of Sciences.

REAUMURIA, in *Botany*, so called in honour of the great French naturalist, René Antoine Ferchault de Reaumur, principally known, as a botanist, by his examination of the fructification of *Fuci*, but chiefly celebrated as a philosophical inquirer into the history of insects, and their transformations, to which the specific name of the original species, *vermiculata*, evidently alludes. Linnæus mentions Hasselquist as the author of the name *Reaumuria*; of which we can find no traces in his book, though the specimen of the plant in the Linnæan herbarium, has some appearance of having been gathered by this distinguished Oriental traveller. Is it possible, that the *Anonyma dubia*, n. 15, of his *Iter Palæstinum*, 465, which his editor Linnæus could not make out, can be the *Reaumuria*? The description is not inapplicable, except what concerns the stamens and style. Yet this does not make him the author of the name, though it may possibly account for Linnæus's mention of him in conjunction therewith. The latter appears, by his manuscripts, to have once destined *Vermicularis* for

the generic appellation.—Linn. Gen. 276. Schreb. 371. Willd. Sp. Pl. v. 2. 1249. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 3. 327. Juss. 316. Lamarck Illustr. t. 489. Dict. v. 6. 84.—Class and order, *Polyandria Pentagynia*. Nat. Ord. *Succulentæ*, Linn. *Ficoideæ*, Juss.

Gen. Ch. Cal. Perianth inferior, of five prominent, ovate, pointed, permanent leaves. Cor. Petals five, oblong, equal, sessile, rather longer than the calyx, oblique, or lobed, at the extremity. Nectary of five double, fringed scales, at the meeting of the petals, attached to their lower part. Stam. Filaments numerous, capillary, the length of the calyx, inserted into the receptacle; Desfont.; anthers roundish, incumbent. Pist. Germen superior, roundish; styles five, thread-shaped, erect, approaching each other, on a level with the stamens; stigmas simple. Peric. Capsule ovate, of five cells, with five flat, at length reflexed, valves; the partitions membranous, unconnected, deciduous. Seeds several, erect, oblong, entirely clothed with numerous, silky, simple hairs, twice their own length.

Eff. Ch. Calyx of five leaves. Petals five, with ten fringed scales at their base. Capsule of five cells, with five valves, and five deciduous partitions. Seeds several, oblong, hairy.

Obs. Specimens in seed, from professor Desfontaines, have enabled us to reconcile his account, and that of Linnæus, with the observation of Forskall, that "the capsule has only one cell," the partitions being deciduous, and concealed among the hairy seeds. Not having examined the nectariferous scales, we have, in advertent to Labillardiere's and Hooker's plates of the second species, made the description so general as to accord with both.

1. *R. vermiculata*. Saltwort-leaved Reaumuria. Linn. Sp. Pl. 754. Willd. n. 1. Forsk. Ægypt. Arab. 101. Desfont. Atlant. v. 1. 431. Lamarck Illustr. t. 489. f. 1. (*Sedum sieulum maritimum vermiculatum*, flore Saxifragæ albæ, femine villoso; Bocc. Sic. 6. t. 4. f. C, G. S. minimum arboreescens vermiculatum; Lob. Ic. 380. Kali vermiculatum albo et amplexu rosei flore; Barrel. Ic. t. 888. *Vermicularis frutex minor*; Ger. Em. 523; at least the figure, which is that of Lobel. The description accords rather with *Salsola frutescens*, as cited by Hudson.)—Leaves linear-awl-shaped, convex beneath. Calyx entire.—Native of barren sandy ground towards the sea, in Sicily, Barbary, Egypt, and Syria, flowering in summer. The habit of the plant is like a *Tamarix*, or *Salsola*. Stem shrubby, bushy, much branched, round, smooth, whitish, leafy. Leaves numerous, scattered, sessile, from a quarter to three quarters of an inch long, spreading, linear-awl-shaped, acute, fleshy, smooth, glaucous; convex beneath; flat above; dotted on both sides with minute depressions. Desfontaines compares the leaves to those of *Sedum reflexum*. Flowers terminal, solitary, white, not unlike those of *Saxifraga corymbosa*, each encompassed with a number of imbricated floral leaves, like those of the stem or branch, but longer. Calyx-leaves ovate, with a narrow, entire, membranous edge, and awl-shaped leaf-like point. Petals terminating in three slight lobes, well represented by Barrelier. Capsule brown, very smooth, and somewhat shining; its valves rigid, reflexed after the seeds are discharged, and permanent. Seeds clothed with long, tawny, shining hairs. Forskall says this plant is used at Alexandria as a cure for the itch, being applied bruised externally, and taken internally in the form of a decoction. It is an elegant little shrub, well worthy of a place in our gardens, or green-houses, to which it is as yet a stranger.

2. *R. hypericoides*. Elliptic-leaved Reaumuria. Willd. n. 2. Ait. n. 1. Lamarck f. 2. (*R. linifolia*; Salisb. Parad.

Parad. t. 18. *Hypericum alternifolium*; Labillard. Syr. fasc. 2. 17. t. 10.)—Leaves elliptic-lanceolate, flat. Calyx minutely crenate.—Gathered in barren dry ground, near the desert of Syria, by M. Labillardiere, to whom we are obliged for a wild specimen. The plant is said to have been introduced into England, by the late Mr. John Bell, about 1800, and is marked by Mr. Aiton as a hardy perennial. Its true genus is well ascertained by Lamarck, Poiret, and Salisbury. 'The stem is herbaceous, about a foot high, simple, or branched, smooth, pale or reddish.' Leaves alternate, glaucous, from half an inch to an inch in length, elliptic-oblong, or somewhat lanceolate, varying greatly in breadth, dotted all over. Flowers terminal, solitary, pale rose-coloured, with oblique petals. Calyx-leaves broader than in the former, their membranous edges finely crenate, their points very small. We know nothing of the capsule or seeds.

REAY, in *Geography*, a town of Scotland, in the county of Caithness; 6 miles W. of Thurso.

REBACH, a river of France, which runs into the Rhine, nearly opposite to Mannheim.

REBAIS, a town of France, in the department of the Seine and Marne, and chief place of a canton, in the district of Coulommiers; six miles E.N.E. of it. The place contains 1256, and the canton 11,284 inhabitants, on a territory of 190 kilometres, in 18 communes.

RE-BAPTISANTS, a religious sect, who maintain, that persons irregularly baptized are to be baptized afresh.

The Anabaptists are re-baptizants, inasmuch as they baptize those at maturity, who had been before baptized in childhood.

St. Cyprian and pope Stephen had mighty differences about the re-baptization of converted heretics.

Donatus was condemned at Rome in a council, for having re-baptized some persons, who had fallen into idolatry after their first baptism.

REBAT, in *Geography*. See RABAT.

REBATE, in *Architecture*. See JOINERY and PLANE.

REBATE, or *Rabat*, *Rebatement*, in *Commerce*, a term much used at Amsterdam for a discount or abatement in the price of certain commodities, when the buyer advances the sum in hand, for which he might have taken time. See DISCOUNT.

Rebate (among us usually called *prompt payment*) is estimated by months, and is only allowed for certain kinds of merchandizes, which, according to the custom of Amsterdam, are

15 months, or 10 *per cent.* on German, Prussian, and Polish wools.

18 months, or 12 *per cent.* on brown Muscovado sugar, pot-ashes, soda, Italian Armoifines, satin, damask, and silk stuffs.

21 months, or 14 *per cent.* on Spanish wool and lamb's wool.

33 months, or 22 *per cent.* on Italian silk and raw silk from the Levant, which silks are sold by the Antwerp weight, about 5 *per cent.* lighter than that of Amsterdam.

Dutch cloths, camlets, &c. are sold with 4 *per cent.* rabat, for ready money, or without any rabat at 9 months' credit.

Dutch silk stuffs are sold with 2 *per cent.* rabat at 6 months' credit: with 4 *per cent.* at 3 months; or with 6 *per cent.* for ready money.

In all sales of goods, except those last mentioned, a further abatement is made of 1 or 2 *per cent.* for prompt payment.

At Hamburg, some sorts of merchandize, when sold in

large quantities, have an allowance made of 7, 13, or 19 months rabat, reckoned at 8 *per cent. per annum*; which the buyer, when he pays ready money, or pays within four weeks of the day of sale, deducts from the nominal price.

Refined sugars, English and Dutch cloths, English baize, shalloons, flannels, kerseymeres, ratteens, and serges, are sold with 7 months' rabat, or 4 *per cent.*; that is, 4 is deducted from 104, or 7 from 157.

Cotton, cinnamon, cochineal, indigo, ginger, nutmegs, cloves, mace, rice, raw sugars, capers, currants, cumine, gall-nuts, Russian leather, linen, crape, Italian silks, table-linen, Silesia cloth, Marfeilles soap, almonds, sumac, molasses, Turkish yarn, Italian tartar, are sold with 13 months' rabat, or 8 *per cent.*; that is, 13 is deducted from 163. Silks from the Levant, as Ardassette, Barutine, and Cербаси, are sold with 16 months' rabat, or 10 *per cent.*; that is, 8 is deducted from 83. Kelly's Un. Camb. vol. i.

This interest, called *rebate*, or *rabat*, is usually regulated on the footing of 8 *per cent. per annum*.

The reason of this expedient is, that the merchants having not always wherewithal to pay for their goods in hand, by means of the rebatement, such as have, will find their account in it; and such as have not will be engaged to discharge themselves as soon as possible, for the sake of the discount.

REBATEMENT, in *Heraldry*, a diminution or abatement of the dignity of the figures or bearing in a coat of arms. See ABATEMENT.

REBEBE, in *Commerce*, a measure of corn in Egypt, particularly at Alexandria, equal to about 4 $\frac{1}{2}$ bushels; as *kifloz*, another measure, is equal to 4 $\frac{1}{2}$ bushels, English measure: 17.94 rebebes are equal to 10 English quarters, and each of them contains 9587 cubic inches; and 16.51 kiffos are equal to 10 English quarters, and each contains 10418 cubic inches.

REBEC, a musical instrument resembling a fiddle, with a neck, finger-board, three strings tuned 5ths, and played with a bow.

Etymologists have tortured themselves to find a derivation for the name of a vulgar instrument, no longer in use. Some trace it from the Arabic, some from the Celtic, the Welsh, the Spanish, Italian, and old French. Indeed, so numerous, discordant, and unsatisfactory are their opinions, as neither to be worth writing, nor perusal, if we could give them a place.

Rebec and ribble seem to be the same instrument, and are often indiscriminately used by Gower, Chaucer, and the still more ancient bards of Normandy, and our own country.

As the head, or scroll-work, of old viols and violins used to be curiously carved, so seems to have been that of the rebec. Chaucer compares the face of an old woman, an old trot, to the head of a rebec. Rabelais does the same.

—“A tel minefrier tel rebec
Tenant toujours le verre au bec
Car elle avoit visage de rebec.”

REBECCO, in *Geography*, a town of Italy, in the department of the Panaro; 29 miles S.W. of Modena.

REBEL, JEAN-FERRY, sen. in *Biography*, one of the 24 violins of the king of France's band, and chamber composer to his majesty. He beat time for many years at the opera, and, in his day, passed for a great composer. His music for dances is still heard with pleasure. His capriccios, freaks, and dancing characters, have enjoyed great reputation. In 1703 he set the opera of Ulysses, written by Guichard.

Rebel

Rebel left two children: Francis, who died in 1775, and Anne, the wife of the celebrated Lalande, master of the king's band.

REBEL, FRANÇOIS, knight of St. Michael, master, like his father, of the king's band, and director of the opera, born 1702, and died in 1775. He was the son of Jean-Ferry Rebel, director of the orchestra at the opera, and one of the twenty-four violins of the king's band. His son had obtained the reversion, in 1717, of chamber musician to the king, and in 1703, that of composer; having given proofs of his abilities by many different works, but, above all, by his "Pyramus and Thisbe," composed in partnership with Francœur.

He was successively appointed to all the musical posts of honour and profit under the royal patronage and that of the public. The close and uninterrupted friendship between this musician and Francœur, does honour to the memory of both; having composed jointly, for 50 years, successful pieces, without discovering to which of them the greatest honour was due. Laborde. See FRANCŒUR.

REBELLION originally signified a second resistance or rising of such as had been formerly overcome in battle by the Romans, and had yielded themselves to their subjection.

It is now generally used for a traitorous taking up of arms against the king, either by his own natural subjects, or by those formerly subdued; whether their view be to deprive him of the supreme authority, or whether they intend to resist his commands in some particular affairs, in order to impose conditions on him. Popular commotion is a concurrence of people, tumultuously assembled, and resisting the voice of their superiors, whether their designs be against those superiors themselves, or only some private persons. Such violent commotions are common when the people think themselves aggrieved, and are occasioned by no order of men so frequently as the tax-gatherers. (See the next article.) If the rage of the malcontents be particularly levelled at the magistrates, or others vested with the public authority, and they proceed to a formal disobedience or violent proceedings, it is called a "sedition." When the evil spreads, infecting great numbers in the city or provinces, and subsists in such a manner, that the sovereign is no longer obeyed, such a disorderly custom has more especially distinguished by the name of "insurrection." All these violences disturb the public order, and are crimes of state, even when arising from just causes of complaint. For violent measures are interdicted in civil society; the injured party should have recourse to the magistrates, to whom they may apply for redress; and if justice be not obtained from them, their complaints may then be laid at the foot of the throne. Every citizen should even patiently suffer supportable evils, rather than disturb the public peace. Nothing less than a denial of justice from the sovereign, or affected delays, can excuse the furious commotions of a provoked people; they in some measure justify themselves, if the evils be intolerable, and the oppressions great and manifest. But, it may be asked, what conduct shall the sovereign observe towards the insurgents? The reply in general is, that which shall at the same time be most consonant to justice, and most salutary to the state. If he is to repress those who unnecessarily disturb the public peace; he is, by the same reasoning, to shew clemency towards unfortunate persons, to whom just cause of complaint has been given, and who are guilty only in having undertaken to do themselves justice; so that they have been wanting in patience rather than fidelity. The sovereign should consider that his rights are derived from those of civil society, from the trust reposed in him, from the obligation devolved upon him of watching over the

welfare of the nation, of procuring its greatest happiness, and of maintaining in it order, justice, and peace. He will also duly distinguish the nature and degree of the different disorders which may disturb the state, oblige him to take arms, or substitute the means of force instead of those of authority. By considerations of this kind he will regulate his behaviour towards revolted subjects. It cannot be questioned, that subjects rising against their prince without cause deserve severe punishments; yet in this case the number of delinquents calls for the sovereign's clemency; shall he depopulate a city, or desolate a province, in punishing their rebellion? Such a chastisement, however just in itself, becomes a cruelty when extended to so great a number of persons. Had the insurrection of the Netherlands against Spain been totally unwarrantable, every man of virtue would still execrate the memory of the duke of Alva, who made it his boast that he had caused above 20,000 heads to be struck off by the hands of the common executioner. Let not his sanguinary imitators (says the excellent Vattel) expect to justify their enormities by necessity. Who was ever more undeservedly insulted by his subjects than Henry the Great of France? His conquests were ever accompanied by an uniform clemency, and at length that excellent prince obtained the success he deserved: he thereby gained over faithful subjects; whereas the duke of Alva lost his master the United Provinces. Tyrants alone will treat, as seditious, those brave and resolute citizens, who exhort the people to preserve themselves from oppression in the vindication of their rights and privileges; a good prince will commend such virtuous patriots, provided their zeal be tempered with moderation and prudence. If he has justice and his duty at heart; if he aspires to that immortal and unsullied glory of being the father of his people; let him mistrust the selfish suggestions of a minister, who represents to him as rebels all those citizens who do not hold out their hands to chains, who refuse tamely to suffer the strokes of arbitrary power.

The safest, and the most just way thoroughly to appease sedition, is to give the people satisfaction; and if the insurrection has been without cause, which perhaps has never been the case, still an amnesty is to be granted where the offenders are numerous. When this amnesty is once published and accepted, whatever has past must be buried in oblivion. A prince who makes any conscience of his word, is faithfully to keep what he has promised to rebels themselves; *i. e.* to those subjects who have revolted without reason or necessity. If his promises are not inviolable, what security have the rebels in treating with him? When they have once drawn the sword, they have nothing to do but, as one of the ancients expresses it, to throw away the scabbard. The prince will then want the mild and salutary means of appeasing a revolt: to exterminate the rebels will be the only expedient remaining. These will become formidable through despair: compassion will bestow succours on them; their party will increase, and the state will be in danger. Vattel's Law of Nations, b. iii. See CIVIL WAR.

Rebel is sometimes also used, in our ancient statutes, for a person who wilfully breaks a law; and sometimes for a villain disobeying his lord.

REBELLION, *Commission of*. See COMMISSION.

REBELLIOUS ASSEMBLY, a gathering of twelve persons, or more, intending, going about, or practising, unlawfully, and of their own authority, to change any laws of the realm, or to destroy the inclosure of any park or ground inclosed, banks of fish-ponds, pools, conduits, &c. to the intent the same shall remain void, or that they shall have way in any of the said grounds; or to destroy the deer in any park, fish in ponds, coney in any warren, dove-houses,

houses, &c. or to burn stacks of corn, or to abate rents, or prices of victuals. See RIOT, ROUT, and UNLAWFUL *Assembly*.

REBENSOE, in *Geography*, a small island in the North sea, near the coast of Norway. N. lat. 70° .

REBHIAN, one of the Hebrew accents, answering to our comma, and enumerated among their kings and pauses. It is marked by a dot over the middle of a letter. See ATTACH, SYLLUK, &c. See also ACCENTS.

REBINARE, was to give a second stirring or ploughing to arable land that lay fallow, to prepare it for sowing wheat, &c. or to plough the ground a third time for that purpose. "Tempus rebinandi erit post festum Nativitatis sancti Johannis Baptiste cum terra pullulaverit post caru-
cani." Fleta, lib. ii. cap. 73.

REBNITZ, in *Geography*. See RIBNITZ.

REBORDAOS, a town of Portugal, in the province of Tras los Montes; two miles S. of Bragança.

REBOUND. See RECOIL.

REBOUX, in *Geography*, a town of France, in the department of Mont Blanc; 9 miles N.W. of Chambéry.

REBTORF, a town of Bavaria, in the principality of Aichstatt; 3 miles W. of Aichstatt.

REBUS, a name-device, as Camden englishes it; or an enigmatical representation of some name, &c. by using figures or pictures, instead of words, or parts of words. Such is that of the gallant mentioned by Camden, who expressed his love to Rose Hill, by painting in the border of his gown a rose, a hill, an eye, a loaf, and a well; which, in the rebus style, is read, *Rose Hill I love well*.

The Picards have the honour of the invention of this notable kind of wit; whence the French, to this day, call it *rebus de Picardie*. Camden adds, that the English first learnt it of them in the reign of our Henry III. by means of the garrisons we then had in Calais, Guienne, and other places bordering on Picardy.

Its origin is by Menage, &c. ascribed to the priests of Picardy, who, it seems, anciently, in carnival time, used every year to make certain libels, entitled *de rebus que geruntur*, being raileries on the intrigues and transactions that had passed about the city; in which they made great use of such sort of equivoques and allusions, breaking and joining words, and supplying them with paintings.

Camden tells us, the rebus was in wonderful esteem among our forefathers; and that he was nobody who could not hammer out of his name an invention by this wit-craft, and picture it accordingly.

The Sieur des Accords has made an ample collection of the most famous rebuses de Picardie. And Mr. Camden has done something of the same kind in his Remains.

Abel Drugger's device in Ben Johnson's Alchemist, and Jack of Newbury, in the Spectator, are known to every body. But the rebus, being once raised to sign-polts, grew out of fashion at court.

Yet has rebus antiquity on its side, as having been in use in the pure Augustan age: Cicero, in a dedication to the gods, inscribed Marcus Tullius, with a little pea, called by the Latins *cicer*, by us a *chick pea*. And Julius Cæsar, in some of his coins, used an elephant, called *Cæsar* in the Mauritanian tongue. Add to these, that the two mint-masters in that age, L. Aquilius Florus, and Voconius Vitulus, used, the first a flower, the second a calf, on the reverse of their coins.

REBUS, in *Heraldry*, a coat of arms which bears an allusion to the name of the person: as three castles, for Castleton; three cups, for Butler; three conies, for Conisby; a kind of bearings which are of great antiquity.

Rehus is also used by the chemical writers, sometimes to signify four milk, and sometimes for what they call the ultimate matter of which all bodies are composed.

REBUTTER, from *re*, and the French *bouter*, to *repel*, or *bar*, in *Law*, the answer of the defendant in a cause to the plaintiff's sur-rejoinder.

The plaintiff's answer to the defendant's rebutter, is called a *sur-rebutter*.

REBUTTER is also when a man warrants any land or hereditament to another, and the person making the warranty, or his heir, sues him to whom the warranty is made, or his heir or assignee, for the same thing: if he, who is so sued, plead the deed or fine with warranty, and pray judgment, if the plaintiff shall be received to demand the thing which he ought to warrant to the party, against the warranty in the deed, &c. this is called a rebutter.

Again, if I grant to the tenant to hold *sine impetitione vasti*, and afterwards implead him for waste, he may debar me of the action, by shewing my grant; which is likewise a rebutter.

REC, in *Geography*, a river of France, which runs into the Sarre, at Sarre Alb.

RECANATI, a town of the marquissate of Ancona; near which towards Macerata are seen the ruins of Helvia Ricina; a town built by the emperor Sept. Severus, and destroyed by the Goths; 8 miles N.N.E. of Macerata. N. lat. $43^{\circ} 25'$. E. long. $13^{\circ} 39'$.

RECANGED, in *Rural Economy*, a term provincially used to signify lifted or discoloured in stripes.

RECANTATION. See PALINODY, or RETRACTATION.

RECAPITULATION, in *Oratory*, &c. a part of the peroration, or conclusion; called also *anacephaleosis*.

Recapitulation is a summary of the preceding discourse; or a concise, transient enumeration of the principal things insisted on at large in it; by which the memory of the hearer is refreshed, and the force of the whole collected into one view.

An instance of this may be given in the peroration of Cicero's Manilian: "Quare, cum bellum ita necessarium sit, ut negligi non possit: ita magnum, ut accuratissime sit administrandum; & cum ei imperatorem præficere possitis, in quo sit eximia belli scientia, singularis virtus, clarissima auctoritas, egregia fortuna; dubitabitis, Quirites, quin, &c."

In order to constitute a good repetition or recapitulation, it must be short and concise: it is also convenient to recite things in the same order in which they were at first laid down; but sometimes a repetition is made, by running a comparison between the speaker's own argument, and those of the adverse party, and placing them in opposition to each other; and this method Cicero takes in the conclusion of his third oration upon the Agrarian law. In some cases, when the discourse is very long, and the arguments insisted on have been many, the orator only mentions such things which he thinks of least consequence, by saying that he omits or passes over them, till he comes to what is of greater moment, which he represents more fully. Ward's Orat. vol. i. sect. 18. See PREFERITION.

RECAPTION, RECAPTIO, or *Reprisal*, in *Law*, is a remedy given to the party himself for an injury to his personal property. This happens, when any one hath deprived another of his property in goods or chattels personal, or wrongfully detains one's wife, child, or servant; in which case the owner of the goods, and the husband, parent, or master, may lawfully claim and retake them, wherever he happens to find them, so it be not in a riotous manner,
or

or attended with a breach of the peace. Thus, *e. gr.* if my horse is taken away, and I find him in a common, a fair, or a public inn, I may lawfully seize him to my own use; but I cannot justify breaking open a private stable, or entering on the grounds of a third person to take him, except he be feloniously stolen, but must have recourse to an action at law. Recaption is unlawful, if it be done with intention to smother or compound a larceny. See *RESTITUTION of Stolen Goods*.

RECAPTION also is the taking a second distress of one formerly distrained for the same cause, and also during the plea grounded on the former distress.

Recaption is also the name of a writ lying for the party thus distrained to recover damages. See *REPLEVIN*.

RECAPTURE, in *Naval Insurance*, denotes the recovery of a ship, or its cargo wholly or in part, after having been taken by an enemy. For every loss occasioned by capture, whether lawful, *i. e.* when made by a declared enemy, according to the laws of war, or unlawful, *i. e.* when it is against the rules established by the law of nations, whether by friends or enemies, the insurer is liable, agreeably to the comprehensive and express words of the policy: and in every case of capture the insurer is answerable, to the extent of the sum insured, for the loss actually sustained. This may be either *total*, as where the ship and goods insured are not recovered; or *partial*, as where the ship is recaptured or restored before abandonment; in which case the insurer is bound to pay the salvage, and any other necessary expence the insured may have incurred by the recovery of his property. The insurer is liable for a loss by capture, whether the property in the thing insured be changed by the capture or not. As to the length of possession by an enemy, which is deemed sufficient to divest the property out of the original owner, or the effect of a recapture in revesting it; these are matters which can never now come directly in question between the insurer and insured, in any case of insurance upon real interest. In gaming insurances, or insurances without interest, indeed, when there was a recapture, the claim, as for a total loss, seems formerly to have involved the question, whether the property in the thing insured had, by the capture, or any proceeding founded on it, been divested out of the original owner, or not, before the recapture. Nevertheless, when a ship is insured "interest or no interest," it has been repeatedly determined, that if the ship be taken, it is a total loss, however illegal the capture may be, and though the ship may be retaken and restored to the owner. But though no question can now arise between the insured and the insurer, as to the effect of a capture or recapture, in divesting or revesting the property; it may not be deemed unimportant to inquire when a capture shall be deemed to transfer the property to an enemy, and what shall be the effect of a recapture in revesting it in the original owner. The general opinion seems to be, that by the law of nations, the property of things captured in war is changed when all reasonable hope of recovering them is gone; and, with respect to things moveable, all reasonable hope of recovering them is presumed to be gone when they are brought within the protection of the enemy's fortrefs. Grotius says, that ships or goods, taken at sea, become the property of the captors, when they are brought into the enemy's harbours, or to the place where his whole fleet is stationed; for then all hopes of recovering them may be said to vanish. But, he adds, that by the law of nations, as introduced among European states in more modern times, things are considered as captured, when they have been 24 hours in the power of the enemy. Others deny this rule of the law of nations, and insist on the rule of the Roman law, that the prize must be carried

"*infra præsidia*" before it can become the property of the captors; and by "*præsidia*" Bynkerhoeck understands the camps, the ports, the towns, and the fleets, of the enemy. In our courts of admiralty, however, it has always been holden, by the marine law of England, independent of the statute which commands restitution, and fixes the rate of salvage, the property is not changed in favour of a vendee or recaptor, so as to bar the original owner, till there has been a regular sentence of condemnation: and in the reign of king Charles II., a solemn judgment was given upon this point; and restitution of a ship taken by a privateer was decreed, after she had been fourteen weeks in the enemy's possession, *because she had not been condemned*. The same doctrine has, in several instances, prevailed in our courts of common law. In one case it was holden that nine days' possession by the captor, and in another, that four years' possession, and several voyages performed, will not change the property, without a sentence of condemnation.

In general, whenever a ship is taken by the enemy, the insured may abandon, and demand as for a total loss; and he is not bound to make any claim or appeal in the enemy's courts of admiralty, or to litigate there the validity of the capture.

But the insured is in no case bound to abandon; and, as the law now stands, no capture by the enemy can be so total a loss as to leave no possibility of recovery, for the *jus postliminii* continues for ever, except in the case of a captured ship converted into a ship of war. (Stat. 33 G. III. c. 66. § 42.) If the owner himself should retake his ship or goods, he will be fully intitled to them; and if they be retaken at any time, whether before or after condemnation, he will be intitled to restitution, upon payment of a settled salvage. Stat. 29 G. II. c. 34. § 24; and 33 G. III. c. 66. § 42.

The chance of the owner's recovering his property, does not, however, suspend the demand of the insured, as for a total loss: but in the case of a recapture, justice is done to the insurer by putting him in the place of the insured. In questions upon policies of insurance, the nature of the contract as an *indemnity*, and nothing else, is always liberally considered.

When there has been a capture, whether legal or not, and the ship has been recaptured or restored, the insurer is bound to defray all necessary expences which the insured has been put to for the recovery of his property. He is therefore liable for a sum of money paid by the insured to the captors, as a *compromise made bonâ fide*, to prevent the ship being condemned as prize. See *RANSOM*.

It often happens that a recaptured ship is in a state to prosecute her original voyage; and, in that case, it is the interest of the recaptors, as well as of the other parties concerned, that she should be permitted to do so. The last prize act (stat. 33 Geo. III. c. 66. § 44.) has therefore very properly provided, "That if a ship be retaken before she has been carried into an enemy's port, it shall be lawful for her, if the recaptors consent thereto, to prosecute her voyage; and it shall not be necessary for the recaptors to proceed to adjudication till six months after the recapture, or till the return of the ship to the port from whence she sailed; and the master, owners, or agents, with the consent of the recaptor, may dispose of their cargoes before adjudication: and in case the vessel shall not return to the port from whence she sailed, or the recaptors shall have had no opportunity of proceeding regularly to adjudication within the six months, on account of the absence of the said vessel, the court of admiralty shall, at the instance of the recaptors, decree restitution to the former owners, they paying salvage, upon such evidence as to the court shall, under all the circumstances

cumstances of the case, appear reasonable; the expence of such proceeding not to exceed *fourteen pounds*."

We shall here observe, that there is an obvious difference between capture and arrest of princes; the object of the one is prize, that of the other detention, with a design to restore the ship or goods detained, or to pay the value to the owner. When a ship is detained in a port after a declaration of war, or the issuing of letters of reprisal, this more resembles a capture than a detention, and gives the injured an immediate right to abandon, as for a loss by capture, even though no condemnation be pronounced, and though the ship be afterwards restored. The most frequent cause of detention is an embargo, which is a proclamation or order of state, usually issued in time of war or threatened hostilities, prohibiting the departure of ships or goods from some or all of the ports of such state until further order. An embargo laid on ships and merchandize in the ports of this kingdom by virtue of the king's proclamation, is strictly legal, when the proclamation does not contravene the ancient laws, or tend to establish new ones; but only to enforce the execution of such laws as are already in being, in such manner as the king shall judge necessary. But whether an embargo be legally or illegally laid, the injury to the owner, by the detention of his ship or goods, is the same; and the insurer is equally liable for the loss occasioned by it. If a ship be seized after a cessation of arms and preliminary articles of peace are signed, this shall not be deemed a capture, but only an arrest of princes. For the regulation of salvage upon a recapture, we refer to the article *SALVAGE*.

Capture by an enemy or a pirate, or an arrest of princes, or even an embargo, is *prima facie* a total loss; and immediately upon the capture, or upon a mere arrest, or at any time while the ship continues under detention, the insured may elect to abandon, and give notice to the insurer of his intention so to do; and thus entitle himself to claim as for a total loss from the insurer. For, from the moment of the capture, the owners lose their power over the ship and cargo, and are deprived of the free disposal of them; and, in the opinion of the merchant, his right of disposal being suspended or rendered uncertain, is equivalent to a total deprivation. It would therefore be unreasonable to oblige the insured to wait the event of capture, detention, or embargo.

There is this difference between a policy *upon interest*, and a *wager policy*, that in the one case the insured may, if he thinks proper, abandon the moment he has notice of a capture or detention, and this will bind the underwriters, whatever may be the ultimate fate of the ship; but in the case of a wager policy there can be no abandonment, because the insured has nothing to abandon.

But a capture or arrest does not necessarily, and at all events, terminate in a total loss, so as to entitle the insured to abandon; for as he cannot abandon till he has received advice of the loss; if, at the time he receives such advice, or before he has elected to abandon, he receive advice that the ship or goods insured are recovered, or are in safety, he cannot then abandon; because he can only abandon *while* it is a total loss, and he knows it to be so; not after he knows of the recovery. Therefore, if a captured ship be retaken and permitted to proceed on her voyage, so that she suffers but a small temporary inconvenience; this would only be a partial, and not a total, loss.

On the other hand, a title to restitution upon a recapture does not necessarily, and at all events, deprive the insured of the right to abandon; for if, in consequence of the capture, the voyage be lost, or not worth pursuing; if the salvage be very high; if farther expence be necessary, and

the insurer will not undertake at all events to pay it, he may abandon. The rule is, that, if the thing insured be recovered before any loss is paid, the insured is entitled to claim as for a total, or a partial loss, according to the final event; that is, according to the state of the case at the time he makes his claim. There is no vested right to a total loss, till the insured, having a right to abandon, elects to do so; for he is only entitled to an indemnity for his loss as it stands at the time of the action brought, or offer to abandon.

But if, after a total loss has been actually paid, the thing insured be recovered, the insurer cannot oblige the insured to refund the money he has received; but he shall stand in the place of the insured, and so no injustice is done.

Cases are mentioned by Mr. Serjeant Marshall, which serve as examples to shew, that though a captured ship be recaptured, yet if the voyage be lost, the loss will be total, and the insured will have a right to abandon.

By the marine law, the property was not changed by the capture, till after condemnation: and since the 29 Geo. II. c. 34, the "*jus postliminii*" continues for ever. A recapture does not in all cases prevent the loss being total. If the voyage be absolutely lost, or be not worth pursuing; if the salvage be very high; if further expence be necessary; if the insurer will not engage, at all events, to bear that expence, though it should exceed the value, or fail of success: under these, and many other similar circumstances, the insured may disentangle himself and abandon, notwithstanding there was a recapture. Upon a recapture the property returns to the original owner, pledged to the recaptors for the amount of the salvage: upon the payment of which he is intitled to restitution. If upon a recapture the captain, finding that the voyage cannot be pursued, and, acting fairly for the benefit of all concerned, sell the ship and cargo to pay the salvage, and thereby put an end to the voyage, the insured may abandon and recover as for a total loss. However, a capture does not necessarily amount to a total loss, nor does a recapture prevent its being total. If the captain purchase the ship from the captors for account of his owners, the money paid, being in the nature of salvage, is only partial loss.

To this article we shall subjoin two or three remarks on the subject of abandonment, which do not elsewhere occur. A time should be fixed when the degree of the insurer's responsibility should be ascertained. In several maritime states on the continent, positive regulations have been established, limiting the time, after a loss has happened, within which the insured may abandon. In England we have no such positive regulation, nor any time limited by law for abandoning. But the courts have laid down a rule, better adapted to the purpose; and the rule is, that as soon as the insured receives advice of a total loss, he must make his election whether he will abandon or not. If he determines to abandon, he must give the underwriters notice of this within a reasonable time after the intelligence arrives; and any unnecessary delay in giving this notice will amount to a waiver of his right to abandon; for unless the owner does some act, signifying his intention to abandon, it will be only a partial loss, whatever may be the nature of the loss, or the extent of the damage. If the insurers in any manner prevent the abandonment, they shall pay the whole loss, to the amount of the sum insured. If no intelligence be received of a ship within a reasonable time, it shall be presumed that she foundered at sea: when the time has elapsed which affords that presumption, the insured may abandon, and claim as for a total loss. Marshall on Insurance, vol. ii.

RECARDAINS, in *Geography*, a town of Portugal, in the province of Beira; 6 miles E. of Bragança Nova.

RECCAN. See ARRACAN.

RECCO, a town of the Ligurian republic, near the sea-coast; 11 miles S.E. of Genoa.

RECEIF, a fort and harbour on the coast of Brazil. S. lat. 8° 10'.

RECEIPT, or RECEIT, in *Commerce*, an acquittance or discharge; or a written acknowledgment of having received a sum of money.

Where the receipt is on the back of a bill, &c. it is usually called an *endorsement*.

Among tradesmen the receipt usually makes the second of the three articles of an account; the receipt contains the monies received; the two others the expence, and the return or balance.

By the 44 Geo. III. c. 98, the former stamp duties were repealed, and others imposed; by the 48 Geo. III. c. 149, these last were repealed, and the following were imposed; *viz.*

Receipt or discharge given for or upon the payment of money				Duty.		
				£	s.	d.
Amounting to	2l. and not amounting to	10l.		0	0	2
ditto	10l. - ditto -	20l.		0	0	4
ditto	20l. - ditto -	50l.		0	0	8
ditto	50l. - ditto -	100l.		0	1	0
ditto	100l. - ditto -	200l.		0	2	0
ditto	200l. - ditto -	500l.		0	3	0
ditto	500l. or upwards	-		0	5	0
And where any sum of money whatever shall be therein expressed, or acknowledged to be received in full of all demands				0	5	0

And any note, memorandum, or writing whatsoever, given to any person for or upon the payment of money whereby any sum of money, debt, or demand, or any part of any debt or demand therein specified, and amounting to 2l. or upwards, shall be expressed or acknowledged to have been paid, settled, balanced, or otherwise discharged or satisfied, or which shall import or signify any such acknowledgment, and whether the same shall or shall not be signed with the name of any person, shall be deemed and taken to be a receipt for a sum of money of equal amount with the sum, debt, or demand so expressed or acknowledged to have been paid, settled, balanced, or otherwise discharged, or satisfied, within the intent and meaning of this schedule, and of the foregoing act, and shall be charged with a duty accordingly.

And any receipt or discharge, note, memorandum, or writing whatever, given to any person for or upon the payment of money, which shall contain, import, or signify any general acknowledgment of any debt, account, claim, or demand, debts, accounts, claims, or demands, whereof the amount shall not be therein specified, having been paid, settled, balanced, or otherwise discharged or satisfied, or whereby any sum of money therein mentioned shall be acknowledged to be received in full, or in discharge or satisfaction of such debt, account, claim, or demand, debts, accounts, claims, or demands, and whether the same shall or shall not be signed with the name of any person, shall be deemed and taken to be a receipt for the sum of 500l. or upwards, within the intent and meaning of this schedule, and of the foregoing act, and shall be charged with the duty of 5s. accordingly.

By 43 Geo. III. c. 126, such receipt shall not be available in law or equity as such acknowledgment, or be given in evidence, unless duly stamped as aforesaid.

And all receipts, discharges, and acknowledgments of the description aforesaid, which shall be given for or upon payments made by or with any bills of exchange, drafts, promissory notes, or other securities for money, shall be deemed and taken to be receipts given upon the payment of money within the intent and meaning of this schedule and of the foregoing act.

Exemptions from the preceding Duties on Receipts.

Receipts exempted from stamp duty by any act or acts of the present session, relating to the assessed taxes.

Receipts or discharges given by the treasurer of the navy for any money impretted to or received by him for the service of the navy.

Receipts or discharges given by any agent for money impretted to him on account of the pay of the army or ordnance.

Receipts or discharges given by any officer, seaman, marine or soldier, or their representatives respectively, for or on account of any wages, pay, or pension due from the navy-office, army pay-office, or ordnance-office.

Receipts or discharges given for the consideration money, for the purchase of any share in any of the government or parliamentary stocks or funds, or in the stocks and funds of the governor and company of the bank of England, or of the East India company, or South Sea company, and for any dividend paid on any share of the said stocks or funds respectively.

Receipts given for money deposited in the bank of England, or in the bank of Scotland, or royal bank of Scotland, or in the bank of the British linen company in Scotland, or in the hands of any banker or bankers, to be accounted for on demand, provided the same be not expressed to be received of or by the hands of any other than the person or persons to whom the same is to be accounted for; but if with interest, see *PROMISSORY Notes*.

Receipts or discharges written upon promissory notes, bills of exchange, drafts or orders for the payment of money duly stamped according to the laws in force at the date thereof, or upon bills of exchange drawn out of, but payable in Great Britain.

Receipts or discharges given upon bills or notes of the governor and company of the bank of England; letters by the general post acknowledging the safe arrival of any bills of exchange, promissory notes, or other securities for money.

Receipts or discharges indorfed or otherwise written upon, or contained in any bond, mortgage, or other security, in any conveyance, deed, or instrument whatever, duly stamped according to the laws in force at the date thereof, acknowledging the receipt of the consideration money therein expressed, or the receipt of any principal money, interest, or annuity thereby secured.

Releases or discharges for money by deeds duly stamped according to the laws in force at the date thereof.

Receipts or discharges given for drawbacks or bounties upon the exportation of any goods or merchandise from Great Britain.

Receipts or discharges for the return of any duties of customs upon certificates of over entry.

Receipts or acknowledgments of payments indorfed upon any bills, orders, remittance bills, or remittance certificates, drawn by commissioned officers, masters, and surgeons in the navy, or by any commissioner or commissioners of the navy, under the authority of the act passed in the 35th year of his majesty's reign, for the more expeditious payment of the wages and pay of certain officers belonging to the navy.

RECEIPT.

Receipts or acknowledgments of payments indorsed upon any bills drawn pursuant to any former act or acts of parliament, by the commissioners of the navy, or by the commissioners for victualling the navy, or by the commissioners for managing the transport service, and taking care of sick and wounded seamen, upon and payable by the treasurer of the navy.

If any person shall write or sign any receipt liable to any stamp duty, without being first duly stamped as aforesaid; or with a stamp of a lower value than is herein directed: he shall forfeit 10*l.* if the sum paid or expressed therein shall not amount to 100*l.*; and 20*l.* if the sum amount to 100*l.* or upwards. 31 Geo. III. c. 27. f. 17. 35 Geo. III. c. 55. f. 8.

Every person who shall give any receipt or writing acknowledging the payment of money, in which a less sum shall be expressed than the sum actually paid or received, or who shall separate or divide the sum actually paid or received into divers sums, or shall write off any part of any debt, or demand, or be guilty of or concerned in any contrivance with intent to defraud his majesty, shall forfeit 50*l.* 35 Geo. III. c. 55. f. 9.

And the persons, or their agent, from whom any sum shall be due or payable, and who shall have paid such sum, may provide a stamp with the proper duty, or of some higher rate of duty than required, and demand of the person entitled to such sum, or any agent to whom the same shall have been paid, a receipt for such sum, and also the amount of the duty thereon as aforesaid; and if such person refuse to give such receipt upon demand thereof, or to pay the amount thereof, every such person shall forfeit for each offence 10*l.* 43 Geo. III. c. 126. f. 5.

Stamps denoting the duties under former acts may be used, provided they be applied to receipts of the like amount as required by this act. f. 8.

And all vellum, parchment, and paper liable to any stamp duty as aforesaid, shall be stamped before the same be written or printed upon; or may be brought to the said commissioners or their officers to be stamped within 14 days after such receipts shall be given or bear date, and shall be stamped on payment of 5*l.* over and above the duty; and if brought after 14 days within one calendar month, on payment of 10*l.* over and above the duty. 31 Geo. III. c. 25. f. 19, 20. 35 Geo. III. c. 55. f. 10, 11.

All penalties by this act incurred may be sued for in the courts at Westminster; or any neighbouring justice may hear and determine any offence which subjects the offender to any pecuniary penalty; who may, on complaint made within three calendar months, summon the party accused, and the witnesses, and examine into the matter of fact; and on confession, or the oath of one witness, may give judgment therein, and levy such penalty by distress on the goods of the offender, which, if not redeemed within six days, may be sold; and such penalty shall be distributed half to the king, and half to the informer; and for want of sufficient distress, the offender shall be committed to prison for three calendar months, unless such penalty shall be sooner paid. 31 Geo. III. c. 25. f. 24, 25. 35 Geo. III. c. 55. f. 12, 13.

If any person shall find himself aggrieved by the judgment of such justice, he may, upon giving security to the amount of such penalty and costs, appeal to the next sessions, which shall happen 14 days next after such conviction, on giving reasonable notice; and in case such judgment be affirmed, they may award the person appealing such costs as to them shall seem meet. Id.

Provided, nevertheless, that such justice may, where he

shall see cause, mitigate any such penalty, so as not to reduce the same to less than one moiety thereof over and above the costs. 31 Geo. III. c. 25. f. 26. 35 Geo. III. c. 55. f. 14.

Witnesses not appearing, having been duly summoned, without reasonable cause to be allowed by such justice, or refusing to give evidence, shall forfeit 40*s.* to be recovered in like manner. 31 Geo. III. c. 25. f. 27. 35 Geo. III. c. 55. f. 15.

Persons counterfeiting or forging any stamp hereby directed to be made use of shall be guilty of felony without benefit of clergy. 31 Geo. III. c. 25. f. 29. 35 Geo. III. c. 55. f. 17. 43 Geo. III. c. 126. f. 11.

All powers given by any former act relating to the stamp duties shall extend to this act. 31 Geo. III. c. 25. f. 30. 35 Geo. III. c. 55. f. 18. 43 Geo. III. c. 126. f. 12.

Persons sued or prosecuted on account of any thing done in pursuance of this act may plead the general issue and give the special matter in evidence; and if a verdict be for the defendant, or the plaintiff be nonsuited, treble damages shall be awarded against such plaintiff. f. 15.

By the 44 Geo. III. c. 98, the former duties on legacies under the care of the commissioners for stamp duties were repealed, and new duties were imposed. By the 45 Geo. III. c. 28, additional duties were imposed, and by the 48 Geo. III. c. 149, the following were imposed (being by f. 3. of this last act placed under the provisions of former acts relating to such duties,) and those imposed by former acts were repealed.

Schedule, Part III.

Legacies and succession to personal or moveable estate upon intestacy.

I. *Where the testator, testatrix, or intestate, died before or upon the 5th of April 1805.*

For every legacy, specific or pecuniary, or of any other description, of the amount or value of 20*l.* or upwards, given by any will or testamentary instrument of any person who died before or upon the 5th day of April 1805, out of his or her personal or moveable estate, and which shall be paid, delivered, retained, satisfied, or discharged, after the 10th of October 1808.

Also for the clear residue (when devolving to one person), and for every share of the clear residue (when devolving to two or more persons), of the personal or moveable estate of any person who died before or upon the 5th of April 1805 (after deducting debts, funeral expences, legacies, and other charges first payable thereout), whether the title to such residue, or any share thereof, shall accrue by virtue of any testamentary disposition, or upon a partial or total intestacy; where such residue, or share of such residue, shall be of the amount or value of 20*l.* or upwards, and where the same shall be paid, delivered, retained, satisfied, or discharged, after the 10th of October 1808.

Where any such legacy, or residue, or share of such residue, shall have been given, or devolved, £ s. d.
to or for the benefit of a brother or sister of the deceased, or any descendant of a brother or sister of the deceased; a duty at and after the rate of 2*l.* 10*s.* per cent. on the amount of the value thereof - - - - - 2 10 0

Where to or for the benefit of a brother or sister of the father or mother of the deceased; or any descendant of a brother or sister of the father or mother of the deceased; a duty at and after the rate of 4*l.* per cent. on the amount or value thereof - - - - - 4 0 0

Where

RECEIPT.

Where to or for the benefit of a brother or sister of a grandfather or grandmother of the deceased, or any descendant of a brother or sister of a grandfather or grandmother of the deceased; a duty at and after the rate of *5l. per cent.* on the amount or value thereof - - -

£ s. d.
5 0 0

Where to or for the benefit of any person in any other degree of collateral consanguinity to the deceased, than is above described, or to or for the benefit of any stranger in blood to the deceased; a duty at and after the rate of *8l. per cent.* on the amount or value thereof - - -

8 0 0

II. *Where the testator, testatrix, or intestate, shall have died after the 5th of April 1805.*

For every legacy, specific or pecuniary, or of any other description, of the amount or value of *20l.* or upwards, given by any will or testamentary instrument, of any person who shall have died after the 5th of April 1805; either out of his or her personal or moveable estate, or out of or charged upon his or her real or heritable estate, or out of any monies to arise by the sale, mortgage, or other disposition of his or her real or heritable estate, or any part thereof, and which shall be paid, delivered, retained, satisfied, or discharged after the 10th of October 1808.

Also, for the clear residue, (when devolving to one person), and for every share of the clear residue (when devolving to two or more persons), of the personal or moveable estate of any person who shall have died after the 5th of April 1805, (after deducting debts, funeral expences, legacies, and other charges first payable thereout), whether the title to such residue, or any share thereof, shall accrue by virtue of any testamentary disposition thereof, or upon a partial or total intestacy, where such residue, or share of residue, shall be of the amount or value of *20l.* or upwards, and where the same shall be paid, delivered, retained, satisfied, or discharged after the 10th of October 1808.

And also for the clear residue (when given to one person), and for every share of the clear residue (when given to two or more persons), of the monies to arise from the sale, mortgage, or other disposition of any real or heritable estate, directed to be sold, mortgaged, or otherwise disposed of, by any will or testamentary instrument of any person who shall have died after the 5th of April 1805, (after deducting debts, funeral expences, legacies, and other charges, first made payable thereout, if any), where such residue, or share of residue, shall amount to *20l.* or upwards, and where the same shall be paid, retained, or discharged, after the 10th of October 1808.

Where any such legacy or residue, or any share of such residue, shall have been given, or have devolved, to or for the benefit of a child of the deceased, or any descendant of a child of the deceased; a duty at and after the rate of *1l. per cent.* on the amount or value thereof - - -

£ s. d.
1 0 0

Where to or for the benefit of a brother or sister of the deceased, or any descendant of a brother or sister of the deceased; a duty at and after the rate of *2l. 10s. per cent.* on the amount or value thereof - - -

2 10 0

Where to or for the benefit of a brother or sister of the father or mother of the deceased, or any descendant of a brother or sister of the father or mother of the deceased; a duty at and after the rate of *4l. per cent.* on the amount or value thereof - - -

4 0 0

Where to or for the benefit of a brother or sister of a grandfather or grandmother of the deceased, or any descendant of a brother or sister of a grandfather or grandmother of the deceased; a duty at and after the rate of *5l. per cent.* on the amount or value thereof - - -

£ s. d.
5 0 0

Where to or for the benefit of any person in any other degree of collateral consanguinity to the deceased, than as above described, or to or for the benefit of any stranger in blood to the deceased; a duty at and after the rate of *10l. per cent.* on the amount or value thereof - - -

10 0 0

And all gifts of annuities, or by way of annuity, or of any other partial benefit, or interest, out of any such estate or effects as aforesaid, shall be deemed legacies within the intent and meaning of this schedule.

Exemptions.

Legacies and residues, or shares of residue, of any such estate or effects as aforesaid, given or devolving to or for the benefit of the husband or wife of the deceased, or to or for the benefit of any of the royal family.

And all legacies which were exempted from duty by the 39 Geo. III. c. 73, for exempting certain specific legacies, given to bodies corporate or other public bodies, from the payment of duty.

By f. 43. of 48 Geo. III. c. 149, the commissioners are authorized to remit penalties incurred before passing this act by non-payment of the duty on legacies, if the duty in arrear shall be paid on or before the 31st Jan. 1809.

By f. 44, in all cases not provided for by f. 43, where any receipt for any of the above matters shall be brought to the head office to be stamped after the expiration of three calendar months from the date thereof, it may be stamped on payment of the duty, together with the penalty incurred for not stamping the same in due time: and if the receipt have been signed out of Great Britain, and be brought to be stamped within 21 days after being received in Great Britain, and no penalty to be incurred.

The said duties to be under the management of the commissioners of the stamp duties. 35 Geo. III. c. 52. f. 3.

And in case of specific legacies, where the residue of any personal estate shall consist of property not reduced into money, the person taking administration of such effects, or by whom the duty ought to be paid, may set a value thereon, and offer the duty accordingly; and may, at his own expence, require the stamp commissioners to appoint a person to set such value, and such commissioners may accept the duty set by such person with an appraisement, but if they shall not be satisfied with the value so set, they may appoint a person to appraise such effects, and to set the value thereon, and require the duty to be paid accordingly; but if the person who ought to pay such duty shall not be satisfied with such valuation, he may cause the same to be reviewed by the commissioners of the land-tax of the district where such effects shall be, at their next meeting, if fourteen days have elapsed before such meeting, and if not, at the next succeeding meeting, of which appeal six days notice shall be given to the stamp commissioners; and the said commissioners of the land-tax may appoint a person to appraise such effects, and to set a value thereon, and may hear and determine such appeal in like manner as appeals to them in other cases, and their judgment shall be final; and if the valuation made under the authority of such stamp commissioners shall not be appealed from within the time aforesaid, or shall be affirmed upon appeal, the duty shall be paid accordingly; and if any variation shall be made on such appeal,

appeal, the duty shall be paid according to such variation; and if the duty assessed in manner aforesaid shall exceed the duty offered to and refused by such stamp officers, the expences shall be borne by the person liable to pay such duty. If any dispute shall arise between persons entitled to any such legacy, or residue, or taking administration as aforesaid, respecting the value thereof, or duty to be paid thereon, the duty shall be assessed by such stamp commissioners on reference to them by either party; and if the value of such property shall be in dispute, such stamp commissioners shall cause an appraisement to be made thereof, at the expence of the person liable to pay the duty, in manner aforesaid; and if such person shall be dissatisfied with such valuation, the same shall be reviewed and finally determined by the said commissioners of the land-tax, upon appeal to them within the time and in the manner aforesaid. And if the effects whereon such duty is payable shall be ten miles from London, such persons as shall be deputed by the said stamp commissioners shall act in their stead. f. 22. 36 Geo. III. c. 52.

And if it shall appear to the said stamp commissioners, upon oath, to be administered by a justice, or master extraordinary in chancery, that less duty has been paid than ought to have been, by mistake, without intention of fraud, such mistake may be rectified by such commissioners, who may accept the duty really due within three calendar months, if no suit hath been instituted, and on payment of 10*l.* per cent. thereon by way of penalty. f. 30.

Every person paying or receiving money contrary to this act, who shall within twelve calendar months discover the other party offending, so as he be convicted thereof, shall be indemnified and discharged from all penalties against this act. f. 31.

And all powers of forming acts relating to the stamp duties, not hereby altered, shall be in force, in the execution of this act. f. 42.

Wherever any executor or administrator shall not have paid the said duties within time, the court of exchequer may, on application from the stamp office on satisfactory affidavit, grant a rule for such executor to shew cause why he should not deliver to the commissioners an account on oath of all legacies, or of the personal property paid or payable by him, and why the duties thereon have not been, or should not be forthwith paid, and may make such rule absolute where it appears proper. And registrars of ecclesiastical courts shall, within a month of requisition, deliver to the stamp office an account of wills and letters of administration in their custody, with particulars relating thereto, and extracts from any wills deemed necessary by the commissioners, on payment of fees agreed on or allowed by the ecclesiastical court, on pain of 50*l.* recoverable by information by the attorney-general. 42 Geo. III. c. 99. f. 2, 3.

And by the 5 W. c. 21, the probate of the will or letters of administration of any common soldier or seaman, slain or dying in the service, shall be exempt from the stamp duties. f. 6.

RECEIPT, or *Resceit*, in Law. See RESCEIT.

RECEIPT of Homage. See RESCEIT.

RECEIPT of the Exchequer. See COURT of Exchequer.

RECEIPT, in Medicine. See RECIPE.

RECEIPTS, Auditor of. See AUDITOR.

RECEIVER, or RECIPIENT, in Chemistry, a globe-shaped vessel, which is adapted to the neck or beak of an alembic, retort, or other distillatory vessel, in order to collect, receive, and contain the products of distillations.

Receivers should be made of glass, not only because this matter resists the action of the strongest and most corrosive

substances, but also because being transparent, it allows the operator to see through it, and to judge by the frequency of the drops, if the distillation be too quick or too slow, and also if the quantity and nature of the substances that come over be such as are required.

Almost all receivers are kinds of bottles of different sizes, of a spherical form, the necks of which are cut short, and each of which is pierced with a small hole in its lateral or upper part, to give vent to the air or vapours, which are too expansive. Receivers of this form are called *balloons*; which see. Some receivers are matrasles with long necks. These are generally adapted to the beaks of glass alembics. The long neck serves to keep the belly of the receiver, where the liquor is collected, at a proper distance from the fire.

Receivers have different forms for particular operations. Such are those which have two or three beaks, either to be adapted to other receivers, or to admit at the same time the necks of several distillatory vessels, when the intention of the operator is, that the vapours of different substances should meet in the same receiver. Such also are receivers for essential oils, obtained from aromatic plants distilled with water, which are so made, that they are never full, but that the water runs out, and leaves the oil behind. These are a kind of glass cucurbits, which contract as they rise higher; so that their neck or upper opening is but nearly of a convenient size to receive the beak of the worm. These receivers have another opening about the middle of the swelling or belly; and to this opening is joined a glass tube, which bends and rises vertically along the outer part of the receiver, so as to be within two inches and a half as high as the upper opening. At this height the tube bends again towards the side opposite to the body of the receiver, to pour into another vessel the liquor which arises there. It forms the figure of an S.

When this receiver is to be used, it is to be placed vertically under the beak of the worm. During the distillation, the liquor rises to an equal height in the body of the receiver, and in the crooked tube: when, therefore, the height of the liquor in the receiver becomes greater than the height of the tube, it must begin to flow from the mouth of this tube into another vessel placed on purpose to receive it; but as essential oils are either lighter or heavier than water, and as they are, therefore, always collected either above or under the water, and as the liquor which discharges itself through the tube is taken from the middle part of the receiver, nothing but water can be evacuated at the mouth of the pipe, while the oil always remains in the receiver. With such a receiver distillation may be performed without the trouble of changing the vessels. Macquer's Chem. Dict. See DISTILLATION and LABORATORY.

RECEIVER of an Air-Pump, is part of its apparatus; being a glass vessel placed on the top of the plate, out of which the air is to be exhausted. To an air-pump belong various receivers, of various forms and sizes, and serving for various purposes. See AIR-PUMP.

RECEIVER, Exhausted, in Pneumatics. See EXHAUSTED. And for the method of repairing those that are cracked, see CEMENT.

RECEIVER, Receptor, or Receptator, in Law, is used commonly in the bad sense, for such as knowingly receive stolen goods from thieves, and conceal them.

This offence is only a misdemeanor at common law: however, by the statutes 3 & 4 W. & M. c. 9. and 5 Ann. c. 31. the offender is made accessory to the theft and felony. But because the accessory cannot in general be tried, unless with the principal, or after the principal is convicted, the receivers

receivers by that means frequently eluded justice; to remedy which it is enacted by statute 1 Ann. c. 9. and 5 Ann. c. 31. that such receivers may be still prosecuted for a misdemeanor, and punished by fine and imprisonment, though the principal felon be not before taken, so as to be prosecuted and convicted. And in case of receiving stolen lead, iron, and certain other metals, such offence is, by statute 29 Geo. II. c. 30. punishable by transportation for fourteen years. So that now the prosecutor has two methods in his choice: either to punish the receivers for the misdemeanor immediately, before the thief is taken (Foster. 373.); or to wait till the felon is convicted, and then punish them as accessories to the felony. But it is provided by the same statutes, that he shall only make use of one, and not of both these methods of punishment.

By the same statute also (29 Geo. II. c. 30.) persons having lead, iron, or other metals in their custody, and not giving a satisfactory account how they came by the same, are guilty of a misdemeanor, and punishable by fine and imprisonment. And by statute 10 Geo. III. c. 48. all knowing receivers of stolen plate or jewels, taken by robbery on the highway, or when a burglary accompanies the stealing, may be tried as well before as after the conviction of the principal, and whether he be in or out of custody; and, if convicted, shall be adjudged guilty of felony, and transported for fourteen years. By stat. 21 Geo. III. c. 68. the receiving of any stolen copper, brass, bell-metal, or utensil fixed to any building, or any iron-rails or fencing set up in any court or other place, is made transportation for seven years, or three years' imprisonment to be kept to hard labour. By stat. 21 Geo. III. c. 69. the receiving of stolen pewter of any kind is subjected to the like penalty, although the principal has not been convicted. By stat. 22 Geo. III. c. 58. the receiving of any stolen goods, (except lead, iron, copper, brass, bell-metal, and folder,) is made a misdemeanor, punishable by fine and imprisonment, or whipping, as the court shall appoint; which shall exempt the offender from being punished as accessory, although the principal be afterwards convicted, and the offence shall appear to be grand larceny, or some greater offence. (See LARCENY.) For the punishment of receivers of goods stolen by hum-boats, &c. on the river Thames, see stat. 2 Geo. III. c. 28. § 12. Receivers of linen goods stolen from the bleaching-grounds are, by stat. 18 Geo. II. c. 27. declared felons without benefit of clergy. In France, receivers are punished with death; and the Gothic constitutions distinguished also three sorts of thieves: "unum qui consilium daret, alterum qui contrectaret, tertium qui receptaret et occultaret; pari poena singulos obnoxios."

RECEIVER also denotes an officer, of which there are various kinds, denominated from the particular matters they receive, the places where, or the persons for whom, &c.

As receiver of rents; receiver-general of the customs; receiver of the fines, upon original writs in chancery, &c.

RECEIVER-General of the duchy of Lancaster, is he who gathers all the revenues and fines of the lands of the said duchy, all forfeitures, assessments, &c.

RECEIVER-General of the public revenue is an officer appointed in every county, to receive the taxes granted by parliament, and remit the money to the treasury.

RECEIVER'S Office. See *Greenwich Hospital*.

RECENT FRUITS. See *FRUIT*.

RECEPTACLE of Stall Manure, in *Agriculture*, the place where the various matters from the stalls, and other places where animals are kept, are deposited and laid up.

Some suppose that these places should be a little hollow or excavated; while others are of quite a different opinion, and think that they should be even, or a little raised. A very slight hollowing is, however, probably the best. An experienced writer on this subject suggests, that it is not to be inferred that, because they should be hollow, they should also be deep; as one principal use of them is to bring the rain waters, which fall within the yards or inclosed parts, into a stagnant state, and to let them off superficially, so as to prevent any thing of the ground current kind from carrying away the dung, either in a bodily manner, or in a thick fluid state: they may, in this way, suffer the more watery particles only to pass away into reservoirs, prepared to preserve and keep them for future use. It is believed that two feet on the lower side, or deepest parts, may be taken as a mean depth; but less may often be quite sufficient: and the bottoms of the waste-water channels being laid six or eight inches lower than the rim of the basons, the depth of water which they can contain is, it is concluded, not more than sixteen or eighteen inches, when empty of manure. But it is suggested, as necessary to good farm management, that, soon after the winter's manure has been removed and cleared away, floorings of marle, or some other earthy fertilizing material, mixed with lime, to the thickness of ten or twelve inches, should be spread out over the bottoms of the basons or hollowed parts; by which means a rich compost for grass lands may be formed at small expence, on which all the offal materials of manure which can be collected, free from seeds of weeds, during the summer and autumn, should be deposited. In this manner the receptacles should be filled to the brims, even though no stable manure were put into them during the above two seasons; so that the winter's stall manures may have firm platforms to rest upon, out of the way of water, the great evil which antiquated prejudice so much fears in these manure receptacles, as the prevention of the due maturation of their different contents.

With these receptacles of manure there should be connected drains from the cattle-houses, stalls, and farm-offices, for receiving and conveying the urine, and other liquid matters, from them to these basons or receptacles; and the mouths of their outlet channels should be well guarded, in order to prevent their being choked up by the manure, when piled up to considerable height above them. The reservoirs, pits, or wells, which are made before them, are always to be kept free, for the superfluous water, or other liquid matters of the receptacles, to drain or filtrate into; and thence to pass away in moist weather; or to be pent up in them, in dry warm seasons, for the purpose of being thrown over the piled-up manures, for the promotion of their decay and maturation.

Where there are grass lands lying conveniently below these receptacles and reservoirs for receiving their overflowings, all the different parts of the places, where they are situated, may be made to slope gently towards them; but where land cannot be commanded for favouring this intention, the receptacles or basons should receive no other waters than what are supplied to them by the atmosphere. This regulation may easily be accomplished, simply by raising their rims a few inches higher than the surrounding surfaces, which should be frequently cleared from the manure and litter dropped upon them, depositing all such substances within their rims. The rain-water which falls, in these cases, is to be conveyed to the catch-pools, or the most contiguous common drains. In all cases, that which falls upon the buildings should be conveyed away, without being suffered to pass through the receptacles or basons, unless

unless where liquid manure is more in demand than that of the bulky kind.

From the slow progress made by manures of this sort to maturation, in the winter season, in the open air, even when piled up in the driest situations, on account of its being constantly soaked or saturated with moisture, and exposed to the effects of the cold atmosphere, the plan of giving receptacles of this sort a long oval square form, and covering them with roofs, to free them wholly from rain, as well as to defend them from cold, has been hit upon, and recommended from authority. As by thus affording the articles of manure the means of passing into the state of fermentation, in the winter months, their putrefaction and decay would be beneficially promoted, for the use of the more early crops of the spring. But how far the advantage, gained in this way, may equal or be superior to the expence of building, and extra labour in the removals of the manure, is a point which is by no means yet fully decided. And the superior benefits, which have lately been derived from the use of manure in its more raw or fresh state, render all such schemes perhaps of less importance than would otherwise be the case.

As it is a matter of great consequence to prevent the excessive waste of this sort of manure, which at present frequently takes place in most parts of the country, it has been suggested by an experienced writer, who has attended much to the subject, and thought a great deal upon it, that piling it in shallow receptacles or basins, and conducting the liquor, when not wanted for moistening the piles of manure, which overflows from them, to reservoirs or catch-pools, in order to stop, deposit, and arrest the heavier and more gross particles that may be conveyed in it, and to provide a valuable collection of liquid manure in particular situations, and of rich muddy matters in others, are the most appropriate practical means of accomplishing the matter, in an easy and cheap way, that can be adopted or had recourse to. See DUNG, FARM-YARD, HOMESTAL, MANURE, RESERVOIR, and YARD Manure.

RECEPTACULUM, RECEPTACLE, in *Botany* and *Vegetable Physiology*, is the seventh, or last, part of fructification distinguished by Linnæus, being the common basis, or point of connection, of the others. (See FRUCTIFICATION.) It is evident that such a part must exist, under some shape or other; yet the receptacle is not always distinguished by any particular figure. In simple flowers it is often little more than a mere point; in compound ones it is very remarkable and important, serving, by its differences of structure, to afford very good generic distinctions. The receptacle of the Daisy, *Bellis*, is conical; that of *Chrysanthemum* convex. In *Spharanthus* this part is very nearly globular, while in some species of *Centaurea* and *Carlina* it is either flat, or slightly concave. In *Sonchus* it is naked, destitute of hairs or scales between the florets or feeds; while in *Carduus* it is hairy, and in *Anthemis* variously scaly. This last genus differs, by the character in question alone, from *Chrysanthemum*, whose receptacle is naked; but the character is not quite so natural, in this case, as could be wished. Mr. Brown has observed to us, that it affords not even a certain artificial distinction, in the *Chrysanthemum indicum* of the gardens, Curt. Mag. t. 327; which Willdenow, like M. de Ramatuelle and professor Desfontaines, has referred to *Anthemis*, because they found the receptacle to be scaly. We are convinced they are in the right, and yet this appears to be the very same plant with *Chrysanthemum indicum*, the scales of the receptacle being variable, and sometimes almost, if not altogether, evanescent. Some genera of this class have a cellular, or honeycomb-

like receptacle, as *Onopordum*, and *Tolpis* (*Crepis barbata* of Linnæus). In that case the edges of the cells are variously jagged, toothed, or fringed, and they now and then are scarcely distinguishable from the reticulations or rugosities of some naked receptacles.

The receptacle of the flower, in Linnæan language, means the area or space between the stamens and styles, in certain genera whose germen is inferior; as the whole umbelliferous order, in which the part in question is more or less tumid, often coloured, and assumes a glandular aspect. The receptacle of the seeds is not unfrequently a distinct part from the capsule or its valves, serving to connect the seeds therewith. (See an example of it in REDUTEA.) The rachis, or common stalk of a spike, or spikelet, in *Graffes*, is also termed a receptacle.

In some plants the receptacle undergoes great changes, acquiring a different texture in the fruit, from what it had in the flower. Thus, the whole fruit, as we call it, of the Fig, (see FIGUS,) is a common receptacle, at first coriaceous, and, like the rest of the plant, containing a milky, somewhat acrid, juice. It forms a bag, lined with flowers or florets, and having a small aperture at the top. After the flowers are past, this bag becomes pulpy, coloured, and full of sweet aromatic juice. So the fruit of the Strawberry, (see FRAGARIA,) is but an originally small dry receptacle, subsequently enlarged, and become pulpy, whose outside is studded with naked seeds. In *Broussonetia*, described under our article PAPYRIUS, the separate stalk of each germen becomes the enlarged and pulpy supporter of a naked seed. In *POLLICHA*, (see that article,) the common receptacle of the flowers, minutely scaly, and hardly discernible, in its earlier state, changes to a congeries of white, juicy, sweet, tooth-like scales, elevating the seeds in their appropriate withered perianths, and altogether constituting one of the most extraordinary pulpy fruits that we have ever met with. A similar change of substance is observable in the calyx of the Mulberry, as well as in *Commelina Zanonica*; a change common and natural in the germen of pulpy fruits, though rare in the particular parts of which we have been speaking.

RECEPTACULUM Chyli, in *Anatomy*, that portion of the trunk of the absorbing vessels, into which the lacteal absorbents pour the fluids which they have taken up in the alimentary canal: it is usually rather larger than the neighbouring portions of the vessel, and sometimes very considerably so. See ABSORBENTS.

RECEPTARIUM, a term of reproach used for such physicians as wrote pompous receipts for loads of medicines, more consulting the good of the apothecary than the patient; as also for such as gave receipts for general medicines, to be used at the discretion of people wholly unacquainted with the nature of diseases.

RECEPTION, RECEPTIO, in *Philosophy*, denotes the same with *passion*, considered as opposed to *action*.

RECEPTION is also properly used for the manner of treating or entertaining a person; and the solemnities and ceremonies practised on that occasion. See ENTRY.

The reception of ambassadors is usually performed with a great deal of pomp.

RECEPTION is sometimes also used for the act of approving, accepting, and admitting a thing. See ACCEPTANCE.

The canon law only binds where it is received: the civil law is received in some countries, and not in others.

The French would never receive the council of Trent, the Spanish inquisition, nor the dogmata of the ultramontane canonists.

RECEPTION,

RECEPTION, in *Astrology*, is a dignity befalling two planets when they exchange houses; *e. gr.* when the sun arrives in Cancer, the house of the moon; and the moon, in her return, arrives in the sun's house.

The same term is also used, when two planets exchange exaltation.

RECEPTITIOUS GOODS. See **GOODS**.

RECESSION of the *Equinoxes*. See **PRECESSION** of the *Equinoxes*.

RECESSUS, a word used by some medical writers to express an abscess, or aposthumation.

RECESSUS Imperii, *Recess of the Empire*, a phrase used in speaking of the affairs of Germany; signifying a collection of the votes or determinations of a diet.

At the end of each diet, before it breaks up, they gather together all their resolutions, and reduce them into writing; the act which contains them they call the *recessus imperii*, because made when on the point of retiring.

RECEY *sur Ouse*, in *Geography*, a town of France, in the department of the Côte d'Or, and chief place of a canton, in the district of Chatillon; 15 miles S.E. of Chatillon. The place contains 880, and the canton 5913 inhabitants, on a territory of 260 kilometres, in 17 communes.

RECHABITES, a kind of religious order among the ancient Jews, instituted by Jonadab the son of Rechab; and comprehending his family and posterity.

Their founder prescribed them three things: first, Not to drink any wine. Secondly, Not to build any houses, but to dwell under tents. Thirdly, Not to sow any corn, or plant any vines.

The Rechabites observed these rules with great strictness, as appears from Jerem. xxxv. 6, &c. Whence St. Jerom, in his thirteenth epistle to Paulinus, calls them *monachi, monks*. Jonadab, their founder, lived under Jehoash, king of Judah, contemporary with Jehu, king of Israel; his father Rechab, from whom his posterity were denominated, descended from Raguel or Jethro, father-in-law to Moses, who was a Kenite, or of the race of Ken; whence Kenite and Rechabite are used as synonymous in scripture.

The Kenites entered the promised land with the Hebrews, and dwelt in the tribe of Judah, about the Dead sea. They were distinguished from the Israelites by their retired sort of life, and by their contempt of cities and houses. Serrurius distinguishes the ancient Rechabites descended from, and instituted by, Jethro, from the new Rechabites of Jonadab. The injunction of Jonadab laid no obligation on the other Kenites, nor on the other descendants of Jethro. This they continued to observe above 300 years. Jehu began to reign A.M. 3120, and Jehoia-kim, king of Judah, was put to death A.M. 3405, B.C. 599; but in the last year of Jehoia-kim, king of Judah, Nebuchadnezzar coming to besiege Jerusalem, the Rechabites were forced to take refuge in the city, still, however, lodging in tents. During this siege, Jeremiah received orders from the Lord to converse with the disciples of Rechab, to invite them into the temple, and to offer them wine to drink. But the Rechabites would not accept the offer.

The Rechabites were, probably, led captive, after the taking of Jerusalem by the Chaldeans. (See Psalm lxx.) They returned from their captivity, and settled in the city of Jabez beyond Jordan. (See 1 Chron. ii. 55.) Some have suggested, that the Assidæans of the Maccabees, (1 Macc. ii. 42. vii. 13. and 2 Macc. xiv. 6.) were successors and followers of the Rechabites. Others have con-

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founded them with the Essenes. But it is certain, that the manner of life of the Essenes was very different from that of the Rechabites, as appears from Josephus, Antiq. lib. xviii. cap. 2. who informs us, that the Essenes had fields, and inhabited houses, but had neither wives nor children; and did not perform their religious ceremonies with the other Jews at Jerusalem: all which was contrary to the practice of the Rechabites.

RECHACING, in *Hunting*, the driving back of the deer, or other beasts, into the forests, chaces, &c. which had straggled out into the copses or thickets, &c.

Anciently there were offices of rechacers of the deers bestowed by the king on gentlemen, or old hunters, with salaries for the keeping of running dogs to recharge the deer into the forests, and then to beat the dogs off, without pursuing any farther.

RECHANGE, in *Commerce*. See **RE-EXCHANGE**.

RECHANGE is also used at sea for such tackle as is kept in reserve aboard the ship, to serve in case of failure of that already in use. See **TACKLE**.

The Levantines use the word *respect* or *respit* in the same sense.

RECHARGE of a *Fire Arm*, is a second loading, or charge. The recharge should never be so deep as the first charge, lest the piece, being over heated, should burst.

RECHBERG, in *Geography*, a town of Austria; eight miles N.W. of Grein.

RECHE, a river of France, which runs into the Amblave, near Malmedy.—Also, a town of England, in the county of Cambridge, on the river Cam, formerly a place of great trade, and before the draining of the fens, a port for vessels of considerable burthen; five miles W. of Newmarket.

RECHEAT, in *Hunting*, a lesson which the huntsman winds on the horn, when the hounds have lost their game, to call them back from pursuing a counter-scent.

RECHENBURG, in *Geography*, a town of Saxony, in the circle of Erzgebirg; four miles S.E. of Frauenstein.

RECHIA, a town of Servia; 100 miles W. of Nissa. N. lat. 43° 12'. E. long. 19° 3'.

RECHICOURT, a town of France, in the department of the Meurthe, and chief place of a canton, in the district of Sarrebourg; five miles N. of Blamont. The place contains 992, and the canton 8516 inhabitants, on a territory of 217½ kilometres, in 18 communes.

RECHNITZ, a town of Hungary; six miles S.S.W. of Guntz.

RECHPERG, a town of Austria; two miles N. of Stain.

RECIMUS, among the Romans, a kind of square mantle, or veil, worn by women on the head. Salmastius will have it to have been a sort of gown used by the Roman ladies, and tucked up before with a square pin, of a purple colour.

RECINA, in *Geography*, a town of the marquisate of Ancona; three miles N.W. of Macerata.

RECIPE, in *Medicine*, a prescription, or formula, of a remedy, appointed to be administered to a patient. See **PRESCRIPTION**.

It is thus called, because always beginning with the word *recipe, take*; ordinarily expressed by the abbreviation *R.*

RECIPIANGLE, or **RECIPIENT-ANGLE**, a mathematical instrument, serving to take the quantity of angles; used especially in the drawing plans of fortifications.

The recipiangle was formerly a popular instrument among the French, but little known among us; it is usually very simple,

simple, in form of a square, or rather a *bevel* (which see); consisting of two arms, or branches, rivetted together, and yet moveable, like a sector, on the centre or rivet.

To take an angle with it, they lay the centre of a protractor to the joint, and the degrees cut by the edge shew the quantity of the angle: otherwise the angle made by the two rulers is drawn on paper, and then measured with a protractor.

Sometimes there is a circle divided into degrees added over the centre or rivet, with an index to shew the degrees without a protractor. At other times the under branch is divided.

To measure a salient angle with any of the recipiangles, apply the insides to the lines that form the angle; for a re-entring angle, apply the outides, &c.

RECIPIENDO EXCOMMUNICATO. See EXCOMMUNICATO.

RECIPIENDO *et faciendo attornato*. See ATTORNATO.

RECIPIENT, in *Chemistry*. See RECEIVER.

RECIPIENT, *Italian*, a vessel like a tea-pot, intended for the separation of essential oils from the watery liquor on which they float.

RECIPIENT of an *Air-pump*. See RECEIVER.

RECIPROCAL, RECIPROCUS, something that is mutual, or which is returned equally on both sides, or affects both parties alike.

The end of human society is to afford each other reciprocal aid; there are reciprocal duties between the prince and his subjects, the husband and wife, &c. There is a reciprocal action between the agent and patient.

The *lex talionis* establishes a kind of reciprocation of justice.

If two similar triangles be cut by parallel lines, the sections of the sides will be proportional; and reciprocally, if the sides be cut proportionably, the triangles are similar.

RECIPROCAL, in *Logic*, is applied to terms which have the same signification, or are convertible; as, *reasonable animal* and *man*.

Schoolmen define *reciprocation* a conversion of the several terms in an enunciation. And terms are said to be converted in an enunciation, when the predicate is put in the place of the subject, and, *reciprocally*, the subject in that of the predicate.

Thus, rationality and risibility are said to reciprocate; for we say equally, *a rational is risible*, and *a risible is rational*.

RECIPROCAL, in *Grammar*, is applied to certain verbs and pronouns in some of the modern languages; in regard of their turning or reflecting the noun, or person, upon himself.

Thus the pronoun relative, *himself*, refers Cato to Cato's self.

The abbé de Dangeau defines reciprocal verbs to be those whose nominative is plural, and denotes persons acting mutually on one another: as, *Ces quatre hommes s'entrebattoient*, *these four men fought together*; *Pierre et toi vous vous louez*, *Peter and you praise one another*, &c.

Reciprocal verbs are a species of those which that author calls *pronominals*, and which he distinguishes into reciprocal and identical.

RECIPROCAL, in *Poetry*, is applied to verses which run the same both backwards and forwards; called also *recurrents*. See RETROGRADE.

RECIPROCAL, in *Arithmetic* and *Algebra*, is the quotient arising from the division of unity by any number or quan-

tity. Thus, the reciprocal of $a = \frac{1}{a}$, the reciprocal of $\frac{x}{y} =$

$\frac{y}{x}$, and so on.

RECIPROCAL Equations, in *Algebra*, are those equations which contain several pairs of roots which are the reciprocals of each other. Thus, an equation whose roots are $a, \frac{1}{a}$;

$b, \frac{1}{b}$; &c. is called a reciprocal equation. Some authors

define reciprocal equations, to be those equations whose coefficients proceed in the same order from both extremes, and respectively equal to each other: thus, $x^4 + ax^3 + bx^2 + cx + 1 = 0$, is a reciprocal equation; but this form ought rather to be considered as a necessary property of these equations, by which they may be readily distinguished, than to be employed in the definition of them; it being doubtless the reciprocity of the roots from which they have received their peculiar appellation.

The solution of these equations may always be made to depend upon others of half the original degree, when the equation is of even dimensions; or upon half the dimension minus 1, when it is odd.

Thus far, in fact, this property is not exclusively due to reciprocal equations, as the same may be done in all cases where any similar relation is known to have place between the roots of an equation, whether by multiplication, division, addition, or subtraction; but in these cases there is nothing in the form of the equation by which such relations may be known to have place, whereas in reciprocal equations their reciprocity becomes immediately obvious by the peculiar order of their co-efficient, these being the same from both extremes, both with regard to sign and magnitude. Hence any equation of the form

$$x^m + ax^{m-1} + bx^{m-2} + \dots + bx^2 + ax + 1 = 0$$

is immediately known to be reciprocal, and we may proceed in its solution as follows.

First, if the equation be of odd dimensions, as

$$x^{2n+1} + ax^{2n} + bx^{2n-1} + \dots + bx^2 + ax + 1 = 0,$$

then it is obvious that either +1, or -1, is one of its roots, for either +1, or -1, substituted for x , according as the signs of the co-efficients may require, will obviously render the whole expression equal to zero, and is therefore a root of the equation. The equation may, therefore, be immediately reduced to another of lower dimensions by division, according to the known theory of equations; thus, let the proposed equation be

$$x^5 - 5x^4 + 7x^3 + 7x^2 - 5x + 1 = 0.$$

Here $x = -1$ is obviously one of the roots, as this substituted for x renders the whole equal to zero; and consequently the whole equation is divisible by $x + 1$, according to the known theory of equation, which division being made, we have, for our reduced equation,

$$x^4 - 6x^3 + 13x^2 - 6x + 1 = 0,$$

which is now of even dimension one degree less than the original equation, and still reciprocal. We need, therefore, only consider equations of the latter form; viz. those of which the index of the highest power is an even number.

Let $x^{2n} + px^{2n-1} + qx^{2n-2} + \dots + qx + p + 1 = 0$ be any reciprocal equation, whose roots are $a, \frac{1}{a}$; $b, \frac{1}{b}$;

RECIPROCAL EQUATIONS.

$e, \frac{1}{e}, \&c.$ Then from the theory of equations we may consider this to be made up of the factors $(x - a)(x - \frac{1}{a})(x - b)(x - \frac{1}{b})(x - c)(x - \frac{1}{c}), \&c.$

Or, putting $a + \frac{1}{a} = m, b + \frac{1}{b} = n, c + \frac{1}{c} = r, \&c.$ these become

$$(x^2 + mx + 1)(x^2 + nx + 1)(x^2 + rx + 1), \&c.$$

If, therefore, we really perform this multiplication, and equate the co-efficients, it is obvious, since the multiplication is reduced to half the number of factors, the equation by which the values of $m, n, r, \&c.$ are obtained, will be of only half the dimension of the original equation; and having found these, since

$$\begin{aligned} x^2 + mx + 1 &= 0 \\ x^2 + nx + 1 &= 0 \\ x^2 + rx + 1 &= 0 \end{aligned}$$

we shall have $x = -\frac{m}{2} \pm \sqrt{\left(\frac{m^2}{4} - 1\right)}$

$$x = -\frac{n}{2} \pm \sqrt{\left(\frac{n^2}{4} - 1\right)}$$

$$x = -\frac{r}{2} \pm \sqrt{\left(\frac{r^2}{4} - 1\right)}, \&c.$$

Thus, for example, let there be proposed the equation

$$x^4 + 5x^3 + 7x^2 + 5x + 1 = 0.$$

Multiply together $x^2 + mx + 1$
and $x^2 + nx + 1$

$$\begin{array}{r} x^2 + m \} x^2 + mn \} x^2 + m \} \\ + n \} + 2 \} + n \} \end{array} x + 1$$

Comparing the co-efficients, we have $m + n = 5$, and $mn + 2 = 7$.

$$\text{Hence, } m = \frac{5 + \sqrt{5}}{2}, \text{ and } n = \frac{5 - \sqrt{5}}{2}$$

$$\text{therefore, } x = \frac{5 + \sqrt{5}}{4} \pm \sqrt{\left(\frac{30 + 10\sqrt{5}}{16} - 1\right)}$$

$$\text{and } x = \frac{5 - \sqrt{5}}{4} \pm \sqrt{\left(\frac{30 - 10\sqrt{5}}{16} - 1\right)}$$

which are the four roots of the proposed equation.

From the preceding principles are readily deduced the solution of all reciprocal equations under the 10th power.

$$3d \text{ degree. } x^3 + px^2 + px + 1 = 0.$$

Find z in the simple equation $z + p - 1 = 0$, and call it r ; then

$$x = -1, x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}$$

$$4th \text{ degree. } x^4 + px^3 + qx^2 + px + 1 = 0.$$

Find the two values of z in the equation $z^2 + pz + q - 2 = 0$, and call them r, r' ; then

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

$$5th \text{ deg. } x^5 + px^4 + qx^3 + qx^2 + px + 1 = 0.$$

Find the two values of z in the equation $z^2 + (p - 1)z + q - p - 1 = 0$, and call them r, r' ; then $x = -1$

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

6th deg. $x^6 + px^5 + qx^4 + rx^3 + qx^2 + px + 1 = 0$.

Find the three values of z in the cubic equation $z^3 + pz^2 + (q - 3)z + r - 2p = 0$, and call them r, r', r'' ; then

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

$$x = \frac{1}{2}r'' \pm \sqrt{\left(\frac{1}{4}r''^2 - 1\right)}$$

7th deg. $x^7 + px^6 + qx^5 + rx^4 + px^3 + qx^2 + px + 1 = 0$

Find the three values of z in the cubic equation $z^3 + (p - 1)z^2 + (q - p - 2)z + r - p - q + 1 = 0$, and call them r, r', r'' ; then $x = -1$

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

$$x = \frac{1}{2}r'' \pm \sqrt{\left(\frac{1}{4}r''^2 - 1\right)}$$

8th deg. $x^8 + px^7 + qx^6 + \dots + qx^2 + px + 1 = 0$.

Find the four values of z in the equation $z^4 + pz^3 + (q - 4)z^2 + (r - 3p)z + s - 2(q - 1) = 0$, and call them r, r', r'', r''' ; then

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

$$x = \frac{1}{2}r'' \pm \sqrt{\left(\frac{1}{4}r''^2 - 1\right)}, x = \frac{1}{2}r''' \pm \sqrt{\left(\frac{1}{4}r'''^2 - 1\right)}$$

9th deg. $x^9 + px^8 + qx^7 + \dots + qx^2 + px + 1 = 0$.

Find the four values of z in the equation $z^4 + (p - 1)z^3 + (q - p - 3)z^2 + (r - q - 2p + 2)z + s - r - q + p + 1 = 0$, and call them r, r', r'', r''' ; then $x = -1$

$$x = \frac{1}{2}r \pm \sqrt{\left(\frac{1}{4}r^2 - 1\right)}, x = \frac{1}{2}r' \pm \sqrt{\left(\frac{1}{4}r'^2 - 1\right)}$$

$$x = \frac{1}{2}r'' \pm \sqrt{\left(\frac{1}{4}r''^2 - 1\right)}, x = \frac{1}{2}r''' \pm \sqrt{\left(\frac{1}{4}r'''^2 - 1\right)}$$

A reciprocal equation of the 10th and higher powers, requires the general solution of equations of the 5th and higher powers, and therefore cannot be exhibited analytically. Bonnycastle's Algebra, vol. i.

Binomial equations are all reciprocal equations of a peculiar kind, which renders them all resolvable by means of certain trigonometrical formulæ.

Binomial equations are all reducible to the form $x^m \pm 1 = 0$; or $x^m = 1$; or $x^m = -1$. Where it is obvious, that if m is even, or $m = 2n$, then $x^{2n} = 1$ will have two real roots, viz. $+1$, and -1 ; and $x^{2n} = -1$ will have two of its imaginary roots $+\sqrt{-1}$, and $-\sqrt{-1}$; so that, in both cases, such an equation may be reduced two degrees lower, by dividing it by $x^2 - 1$, or $x^2 + 1$, and the resulting equation will be a reciprocal one, having each of its co-efficients equal to unity. If m be odd, then the equation will necessarily have one real root, and no more, which will be $+1$ in the first case, and -1 in the second; consequently, such an equation can be reduced but one degree, the same as those above stated. We may, therefore, find a direct solution for all binomial equations of odd dimensions as far as the 9th power, and of even dimensions as far as the 10th power, by the principles and formulæ already given, by merely making $p = 1, q = 1, r = 1, \&c.$ and it would, therefore, be useless to repeat them again in this place; we shall proceed immediately to the general solution of binomial equations, on the principles of analytical trigonometry.

All the imaginary roots of the equation

$$x^n - 1 = 0$$

3 U 2

are

RECIPROCAL EQUATIONS.

are contained in the general formula

$$x^2 - 2 \operatorname{cof.} \frac{2k\pi}{n} x + 1 = 0;$$

k being any integer not divisible by n , and π representing the semi-circumference. For it is a known trigonometrical property, that if

$$2 \operatorname{cof.} y = x + \frac{1}{x}, \text{ then } 2 \operatorname{cof.} ny = x^n + \frac{1}{x^n};$$

from which two equations we readily draw the two following; *viz.*

$$\begin{aligned} x^2 - 2 \operatorname{cof.} y \cdot x + 1 &= 0 \\ x^{2n} - 2 \operatorname{cof.} ny \cdot x^n + 1 &= 0 \end{aligned}$$

which have necessarily one common root, being both derived from the same value of x ; and since these are both reciprocal equations, if x be one root, $\frac{1}{x}$ will be another; they have therefore two roots common, and consequently, from the known theory of equations, the former is a divisor of the latter. If, now, we make $y = \frac{2k\pi}{n}$, or $ny = 2k\pi$, these equations become

$$x^2 - 2 \operatorname{cof.} \frac{2k\pi}{n} x + 1 = 0$$

$$x^{2n} - 2 \operatorname{cof.} 2k\pi x^n + 1 = 0$$

But the $\operatorname{cof.} 2k\pi = 1$, 2π representing the whole circumference; therefore the latter equation is the same as

$$x^{2n} - 2x^n + 1 = 0, \text{ or } (x^n - 1)^2 = 0,$$

having still for its divisor

$$x^2 - 2 \operatorname{cof.} \frac{2k\pi}{n} x + 1 = 0;$$

that is, the roots of the equation

$$(x^n - 1)^2 = 0, \text{ or } x^n - 1 = 0,$$

are all contained in the general formula

$$x^2 - 2 \operatorname{cof.} \frac{2k\pi}{n} x + 1 = 0;$$

and, therefore, by giving to k the successive values 1, 2, 3 . . . $\frac{1}{2}(n-1)$, the following formulæ will be obtained; *viz.*

$$x^2 - 2 \operatorname{cof.} \frac{2\pi}{n} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{4\pi}{n} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{6\pi}{n} x + 1 = 0$$

$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$

$$x^2 - 2 \operatorname{cof.} \frac{(n-1)\pi}{n} x + 1 = 0$$

which contain among them all the imaginary roots of the equation $x^n - 1 = 0$.

And if, instead of making $y = \frac{2k\pi}{n}$, as above, we

make $y = \frac{(2k+1)\pi}{n}$, our second formula becomes

$$x^{2n} + 2x^n + 1 = 0, \text{ or } (x^n + 1)^2 = 0;$$

because $\operatorname{cof.} (2k\pi + \pi) = -1$. Consequently, the equa-

tion $x^n + 1 = 0$, or $x^n = -1$, will have for its general factor

$$x^2 - 2 \operatorname{cof.} \frac{(2k+1)\pi}{n} x + 1 = 0;$$

which, by substituting for k as above, becomes

$$x^2 - 2 \operatorname{cof.} \frac{1\pi}{n} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{3\pi}{n} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{5\pi}{n} x + 1 = 0$$

$$\&c. \quad \&c. \quad \&c.$$

which formulæ contain all the imaginary roots of the binomial equation $x^n + 1 = 0$.

Suppose, for example, all the imaginary roots of the binomial equation $x^{11} - 1 = 0$ were required.

Here we should have

$$x^2 - 2 \operatorname{cof.} \frac{360^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{2 \cdot 360^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{3 \cdot 360^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{4 \cdot 360^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{5 \cdot 360^\circ}{11} x + 1 = 0$$

$$\text{whence, } x = \operatorname{cof.} \frac{360^\circ}{11} \pm \sqrt{\left(\operatorname{cof.}^2 \frac{360^\circ}{11} - 1\right)}$$

$$x = \operatorname{cof.} \frac{720^\circ}{11} \pm \sqrt{\left(\operatorname{cof.}^2 \frac{720^\circ}{11} - 1\right)}$$

$$x = \operatorname{cof.} \quad \&c. \quad \&c.$$

And if the roots of $x^{11} + 1 = 0$ were required, we should have from the second general formula

$$x^2 - 2 \operatorname{cof.} \frac{180^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{3 \cdot 180^\circ}{11} x + 1 = 0$$

$$x^2 - 2 \operatorname{cof.} \frac{5 \cdot 180^\circ}{11} x + 1 = 0$$

$$\&c. \quad \&c.$$

Whence,

$$x = \operatorname{cof.} \frac{180^\circ}{11} \pm \sqrt{\left(\operatorname{cof.}^2 \frac{180^\circ}{11} - 1\right)}$$

$$x = \operatorname{cof.} \frac{540^\circ}{11} \pm \sqrt{\left(\operatorname{cof.}^2 \frac{540^\circ}{11} - 1\right)}$$

$$x = \operatorname{cof.} \quad \&c. \quad \&c.$$

For more on this subject, see Barlow's Theory of Numbers, Bonnycastle's Algebra, and our article POLYGON.

RECIPROCAL Figures, in Geometry, are such as have the antecedents and consequents of the same ratio in both figures. See Plate XII. *Geom. fig. 2.* Here

$$\begin{aligned} A : B :: C : D, \text{ or,} \\ 12 : 4 :: 9 : 3 \end{aligned}$$

That

That is, as much longer as the side A, in the first rectangle, is than the side B of the second rectangle; so much deeper is the side C in the second rectangle, than the side D in the first; and, consequently, the length of one is compensated by the depth of the other.

Also, as the side A is $\frac{1}{4}$ longer than the side C, so the side B is $\frac{1}{4}$ longer than D: wherefore the rectangles must be equal.

This is the foundation of that Catholic theorem; that the rectangle of the extremes must always be equal to that of the means; and, consequently, the reason of the rule of three, or golden rule.

For, suppose there were given any three numbers, or quantities, geometrically proportional, as A, B, and C; and, that it were required to find a fourth, D, proportional to them: since $A : B :: C : D$, therefore $AD = BC$, and,

consequently, $D = \frac{BC}{A}$; that is, the fourth term is equal to the quotient of the second, multiplied by the third term, divided by the first.

Or, thus in numbers: suppose given 12, 4, and 9, required a fourth proportional. Now as $12 : 4 :: 9 : Q$.

But $12 Q = 4 \times 9 = 36$. Therefore $Q = \frac{4 \times 9}{12} = 3$,

by dividing both sides by 12.

And hence it follows, that if any two triangles, parallelograms, prisms, parallelepipeds, pyramids, cones, or cylinders, have their bases and altitudes reciprocally proportional, those two figures or solids are equal to one another, and, *vice versa*, if they are equal, their bases and altitudes are reciprocally proportional.

RECIPROCAL Proportion, is when in four numbers the fourth is less than the second by so much as the third is greater than the first; and *vice versa*. See PROPORTION.

This is the foundation of the inverse, or indirect rule of three. Thus, $4 : 10 :: 8 : 6$.

Great use is made of this reciprocal proportion, by Sir Isaac Newton, and others, in demonstrating the laws of motion.

RECIPROCAL Theorem. See THEOREM.

RECIPROCALLY, the property of being reciprocal; thus we say, that in bodies of the same weight, the density is reciprocally as the magnitude; *viz.* the greater the magnitude the less the density; and the less the magnitude the greater the density; so again, the space being the same, the velocity is reciprocally as the time, and the contrary.

RECIPROCITY. The law of reciprocity is a term used by Legendre, in his "Theorie des Nombres," to denote a reciprocal law, which has place between prime numbers of different forms; which is this; that m and n being prime odd numbers,

the remainder of $m^{\frac{n-1}{2}} \div n =$

the remainder of $n^{\frac{m-1}{2}} \div m$

provided m and n are not both of the form $4x - 1$, and if they are both of this form, then

the remainder of $m^{\frac{n-1}{2}} \div n = -$

the remainder of $n^{\frac{m-1}{2}} \div m,$

or they will have only contrary signs.

RECISSION, in Law. See ADEMPITION.

RECIT, Fr, a genetical term in music, for what is sung by a single voice. It is likewise applicable to instruments; as, *recit de basse*, *recit de hautbois*, a solo part for the violoncello

or hautbois. Indeed *recit*, in French, seems synonymous with the word *solo* in Italian, to whatever vocal or instrumental part it is applied, in opposition to *tutti*, or chorus, in which the whole band is employed.

Recit in France is not only a technical term in music, but in the drama, where, at the opening of a tragedy, or subsequent to an event, it implies an account, a narration, the recital of an event. In the French and Italian tragedies, in imitation of the Greeks, battles and murders are always recited, but never transacted on the stage.

RECITAL, in Law, the rehearsal, or making mention, in a deed or writing, of something which has been done before.

A recital is not conclusive, because it is no direct affirmation; and by feigned recitals in a true deed, men might make what titles they pleased, since false recitals are not punishable. If a person, by deed of assignment, recite that he is possessed of an interest in certain lands, and assign it over by the deed, and become bound by bond to perform all the agreements in the deed; if he is not possessed of such interest, the condition is broken; and though a recital of itself is nothing, yet being joined and considered with the rest of the deed, it is material. And where it is but a recital, that before the indenture the parties were agreed to do such a thing, it is a covenant, and the deed itself confirms it. The recital of one lease in another, is not a sufficient proof that there was such a lease as is recited. But the recital of a lease in a deed of release, is good evidence of a lease against the releasor, and those who claim under him. A new reversionary lease shall commence from the delivery, where an old lease is recited, and there is none, &c. A. recites that he hath nothing in such lands, and in truth he has an estate there, and makes a lease to B. for years; the recital is void, and the lease good. In this case, if the recital were true, the lease would not bind.

RECITATION, the act of reciting, or delivering a discourse, either in the way of narration, rehearsal, declamation, or the like.

RECITATIVO, Ital., *Recitative*. The Crusca Dictionary gives no more early authority for the use of this word, as a musical term, than that of Batista Doni, de Præst. Mus. Veteris, published in 1647; who defines it, "a musical composition in an andante or plain style, different from air: it is used in narrative poetry, in imitation of reciting on the stage."

Rousseau's definition is more full and clear. He terms it "a discourse, or speech, in musical and harmonical tones. It is a melody nearly approaching to common speech; a musical declamation, in which the musician ought to imitate, as much as possible, the inflexions of voice in declaiming. This melody is called recitative, because it resembles a narration, a recital; and is used in the dialogue of musical dramas."

We have presented our readers, under the article OPERA, with extracts from the prefaces of the poets and composers by whom recitative was invented, as well as from contemporary writers, who thought its origin of sufficient importance to be recorded.

Giovanni Batista Doni, about the middle of the 17th century, (Op. Omn. tom. ii. in Firenze, 1763, folio,) a learned and elegant writer on music, though extremely warped in his judgment by a predilection for the music of the ancients, in a dissertation on the Origin of Stage-singing, during his own time, gives so curious and instructive an account of the first operas that were performed at Florence, that we shall translate a part of it.

"Some kind of *cantilena*, or melody, has been introduced
in

in dramatic representations, at all times, either in the form of intermezzi (interludes), between the acts; or, occasionally, in the body and business of the piece. But it is still fresh in the memory of every one, when the whole drama was first set to music, and sung from the beginning to the end."

The revival of theatrical music was brought about by the invention of recitative, as we have already stated in our article OPERA.

"The beginning of this century (1600) was the era of musical recitation on the public stage at Florence, though it had been used there in several private exhibitions before. There resided in that city, during these times, signor Gio. Bardi de' Conti di Vernio, who was afterwards called to the service of pope Clement VIII., by whom he was tenderly beloved, and made his maestro di camera. This most accomplished nobleman was particularly attached to the study of antiquity, and to the theory and practice of music, to which he had applied himself for many years so closely, that he became, for the time in which he lived, a correct and good composer. His house was the constant rendezvous of all persons of genius, and a kind of flourishing academy, where the young nobility often assembled to pass their leisure hours in laudable exercises and learned discourse; but particularly on musical subjects, when it was the wish of all the company to recover that art of which the ancients related such wonders, as well as other noble inventions, which had been ruined by the irruptions of barbarians.

"During these discussions, it was universally allowed that as modern music was extremely deficient in grace, and the expression of words, it became necessary, in order to obviate these objections, that some other species of cantilena, or melody, should be tried, by which the words should not be rendered unintelligible, nor the verse destroyed."

Euridice was the first musical drama after the invention of recitative. It was written by Ottavio Rinuccini, set by Jacopo Peri, and performed at Florence in 1600, on occasion of the marriage of Mary of Medicis with Henry IV. of France. The poem and the music were published separately the same year. The poet, in his dedication to the queen of France, says, "It is generally imagined that the tragedies of the ancient Greeks and Romans were entirely sung; but this noble kind of singing had not till now been revived, or even attempted, to my knowledge, by any one; and I used to think, that the inferiority of our music to that of the ancient was the cause; till hearing the compositions of Jacopo Peri to the fable of Daphne, I wholly changed my opinion. This drama, written merely as an experiment, pleased so much, that I was encouraged to produce Euridice, which was honoured with still more applause, when sung to the music of the same composer Jacopo Peri, who with wonderful art, unknown before, had merited the favour and protection of the grand duke our sovereign, it was exhibited in a most magnificent manner at the nuptials of your majesty, in the presence of the cardinal legate, and innumerable princes and nobles of Italy and France."

Such is the abridged history of recitative. The only printed copy of the music to this primitive opera was in the library of the marchese Rinuccini, a descendant of the poet at Florence: in examining and making extracts from which, we observed that it was printed in score, and barred; two very uncommon circumstances at the time of its publication; that the recitative seemed to have been not only the model of subsequent composers of early Italian operas, but of the French operas composed by Lulli, a native of Florence; and that the time was as frequently changed as in the old French operas.

The confusion arising from all the parts singing different words at the same time, together with some other circumstances, mentioned under OPERA, account for the necessity of a recitative, or a *musica parlante*, a speaking music, and for solo singing in general on the stage: besides, poetry was injured, and rendered unintelligible in fugues, canons, and in choruses, full of imitations and contrivances, all unfit for narration and dialogue.

To describe the characteristic difference of recitative from air, and common speech: it is not air, as no time is kept; it is not speech, as every inflexion of voice is in tune with some one note of the instrument by which it is accompanied; and as to the length or shortness of the notes that are written, the accompanier watches for the accents or termination of phrases, or lines in the verse, to give the chord to which the note that is sung belongs.

It is sometimes accompanied by the orchestra with *ritornelli*, or interlittal symphonies; but then a regular time must be kept. This only happens in solemn scenes of dignity or distress, and in soliloquies.

No flats or sharps are placed at the clef in recitative: these are all regarded as accidental; nor is Italian recitative ever confined to any one key.

After recitative was found, it was long ere any thing like an air appeared in these musical dramas. (See OPERA, AIR, MOTIVO, and MEASURE.) Rousseau has treated the article recitative at large, with great intelligence and good taste.

RECITATIVE *Style*, is the way of writing accommodated to this sort of music.

RECIV, LA, in *Geography*, a well-fortified town of Brasil, in the jurisdiction of Fernambuco.

RECKENITZ, a river which separates the duchy of Mecklenburg from Pomerania, and runs into a lake, which communicates with the Baltic near Ribnitz.

RECKHEIM, or REKUM, a town of France, in the department of the Lower Meuse, which gives name to a county, situated on the W. side of the Meuse, and surrounded by the bishopric of Liege; 7 miles N. of Maestricht.

RECKLING, in *Rural Economy*, a provincial word, signifying the last of the farrow or brood of pigs, poultry, or other sorts of domestic birds.

RECKLINGHAUSEN, in *Geography*, a town of Germany, fortified by a castle, and capital of a county of the same name, which is situated between the bishopric of Munster, the duchy of Cleves, and the county of Mark; 16 miles S.S.W. of Munster.

RECKON, in *Rural Economy*, a term sometimes applied to a pair of pot-hooks of a certain make, occasionally employed in dragging wells, ponds, &c.

RECKONING, in *Navigation*, the act of estimating the quantity of a ship's way; or of the distance run between one place and another.

Or, more generally, a ship's reckoning is that account, by which at any time it may be known where the ship is, and on what course or courses she is to steer to gain her port. See LOG-BOARD, LOG-BOOK, and JOURNAL.

This is usually performed by means of the log-line; the manner of applying which, see under its proper article, LOG-LINE.

Yet this is liable to great irregularities. Vitruvius advises an axis to be passed through the sides of the ship, with two large heads projecting out of the ship, in which are to be included wheels touching the water, by whose revolution the space passed over in any given time may be measured. The same has since been recommended by Snellius; but

but there are few who have written of navigation, that have not shewn the insufficiency of this method.

RECKONING, *Dead*. See *DEAD Reckoning*.

RECKSON, in *Geography*, a town of Bengal; 6 miles E. of Calcutta.

RECLAIMING, or RECLAMING, in our *Ancient Customs*, the action of a lord pursuing, prosecuting, and recalling his vassal, who had gone to live in another place, without his permission.

RECLAIMING is also used in a similar sense, for the demanding of a person or thing to be delivered up, or surrendered, to the prince or state it properly belongs to; when, by any irregular means, it has come into the possession of another.

RECLAIMING, in *Falconry*, is the calling of a hawk, or bird of prey, back to the fist.

The sparrow-hawk, gos-hawk, &c. are reclaimed with the voice; the falcon only by shaking the lure. So that the term luring, with regard to the falcon, is more proper than reclaiming.

The partridge is also said to reclaim her young ones, when she calls them together upon their scattering too much from her.

RECLAIMING is also used for taming animals that are wild by nature.

RECLAIMING, in a monastic sense. See *RELIGIOUS*.

RECLAIMING *Land*, in *Agriculture*, the business of restoring and bringing them into a state of cultivation and improvement. There are various kinds and states of land, which admit of this sort of amelioration and improvement; as among the wet forts, all those of the bay or estuary description, which are washed and occasionally covered by the sea or other waters; different descriptions of fen lands, and those of the more firm marshy nature, and those in more interior situations, which are of a loose swampy or watery quality, as morasses and boggy grounds. And among those of the more dry, hard, waste, and wild descriptions; all the varieties of the rough stony sorts of unimproved lands; the many different kinds of rough woody grounds; and the numerous sorts of moory lands, as well as other varieties, which are now and then to be met with in particular circumstances and situations.

The first of the wet or watery sorts of land, noticed above, are far from being always ready, or in a ripe state for admitting improvement of this nature; yet in different situations and circumstances, they occasionally permit of its being accomplished, without any great difficulty or trouble. See *EMBANKMENT*, and *EMBANKING against the Sea*.

The fenny and marshy lands, where, in the former, they are wholly or only in a partial manner overgrown by useless aquatic plants; and in the latter, are become so firm as to bear pasturing flock, and to afford nutritious herbage for their growth and support, but are notwithstanding still liable to be overflowed by high tides, or land floods; are, of course, capable of very great improvement in the above ways, as well as by many other means. See *FEN*, *FENNY Land*, *MARSH Land*, and *SALT Marsh*.

These sorts of watery lands are not incident to the flat bays and inlets of the sea-coasts, or the mouths of the large rivers, in a particular manner; but are met with in the more inland situations of the country, accompanying the larger rivers and waters in the more central parts of the kingdom: consequently such sorts of improvement must be very extensive in their nature, and of very great importance to the nation.

The other kinds of swampy watery lands, which are liable to be covered with that fluid during wet seasons; those on

the sides of lakes and ponds; the morasses which are choaked and grown up with aquatic vegetables, so as to have some sort of hardish crust formed upon them; and the soft boggy lands, formed in somewhat similar ways, are all capable of allowing great improvement, by suitable draining, and other methods of management. See *SPRING* and *SURFACE Draining*, *SWAMP*, *BOG*, and *MORASS*.

Lands of the above kinds are mostly met with on the lower slopes, or at the feet of hilly grounds; being caused by the stagnation of water in their internal parts, which has the effect of chilling and rendering them too moist for the production of a nutritious and useful herbage, as well as of promoting the growth of coarse plants of the aquatic nature, though their situations may occasionally have some degree of relative height.

There are many valuable tracts of land of these kinds, in many different parts of the island, which have been already reclaimed by these methods of proceeding; which should have the effect of stimulating the owners of such lands in other places, where they still remain unimproved, to exert themselves in getting them reclaimed.

Among the more dry kinds of unreclaimed lands, the first, or those of a rough, stony, waste quality, are all those in the valleys of hilly or mountainous tracts, on the skirts or lower parts of mountainous heights, and the rough stony lands, fit for cultivation, in other situations. They are the most readily reclaimed and improved, in the less hilly sorts of lands and situations. In some cases, where the surfaces of the ground were in a great measure covered by large rocks and stones of great sizes, very hard in their qualities, and of scarcely any value, the lands have been reclaimed, and brought into an arable state, and let for high rents: the stones which were removed paying, in a great degree, the expences of the labour; they being exported and sold as paving-stones, and for other uses to the metropolis. And though this cannot always be done, it shews what is capable of being performed by industry and perseverance; and that, where surface stones can be turned to useful purposes, the most rugged and barren lands may be reclaimed with advantage, under proper modes of management. In such instances, instead of leaving the surfaces of the grounds in worse states than they were before, by being taken up with pits, and heaps of useless rubbish, which buried the better moulds, as is common in working superficial quarries, the pits and other hollows were levelled, and filled up to some height, with the coarse and rubbish materials produced in the course of the works, and the finer mould from other parts thrown back upon the above sub-soil materials, so as to form an even top-soil; the larger spaces of the ground being trenched over to a good depth, leaving the best soil on the surface. It is suggested, that by following similar easy methods of management, in carrying on other undertakings of the same kind, lands of a value in proportion to that of the materials which are removed, may commonly be created, without incurring any very great expence. Hence it is thought to behove those who have the direction and management of landed estates, that comprehend grounds of these sorts, to examine and consider well whether the stony materials which they contain, and encumber their surfaces, cannot be turned or converted to some profitable purpose, by the means of roads, iron railways, canals, or some other easy mode of conveyance for such heavy substances.

It must be noticed, however, that the method of levelling and trenching over the lands by the spade, in such circumstances, can only be practised in a very few cases, where labour is particularly cheap.

There is another description of stony lands, of a much less

less formidable nature, which frequently stands in need of being reclaimed, and in which the surface is less encumbered than the interior parts of the soil. In these cases, the interrupting materials are rather large stones than rocks, though the latter may sometimes in part form them. The means which are best suited to the bringing of these into a profitable state of cultivation, are to be found in the more northern parts of the island, in the practice and exertions of particular spirited individuals. The plan of the improvement is perfectly simple, but it is expensive in its performance; the whole of the lands being trenched over, by means of the spade, to a proper depth, as from one to two feet. The stones which are not wanted for use are thrown into pits, and the hollow parts, to contribute to their being made level, and sometimes into the deep trenches formed in digging, being first covered over with the worst of the earthy materials, upon which the better moulds and turfy substance, which are stirred in the work, are spread out as a soil, by which the whole is rendered very suitable for agricultural purposes.

The cost of reclaiming lands in this way depends, in some measure, on the cast of surface in the lands, the nature of the interrupting matters, and the depth of the earthy substances to be removed, in raising a sufficiency of mould for forming the surface soil: but from five to twenty pounds the acre may be considered as the limits of the charges.

And this, it is supposed, leaves an ample profit in the sale of such lands, or otherwise, in these situations where tithes are not taken, and where the rates and taxes are so very few and trifling, and where labour and living is so cheap. It can now, however, be done in this manner in but few instances, as has been already noticed.

It is, notwithstanding, believed that there are very many lands, not only in these northern parts, but in England and Wales, that would more than repay the expences of this spirited mode of improvement. It may be remarked, that where the stones are very large, or where fragments of rocks are met with, in these undertakings, they may be got rid of either by blasting, or rending their upper parts, or by sinking them in the soil, so as to allow the plough to pass over them with safety.

The former method is more suited to the soft sorts of stones; the latter to those of the harder kinds.

Such rocky grounds as are common in hilly and mountainous situations, which, on account of their climate, and the compact nature of the rocky materials, as well as their quantity, are incapable of being cleared as corn-lands, or so as to admit the plough, may often be reclaimed and improved as pasture lands for sheep, &c. or sometimes as hay lands. The plan of proceeding, in these cases, is that of removing the stony matter from the surface, and allowing it entirely to the growth of grassy herbage; the means of accomplishing which are similar to those already noticed, but the cost considerably less: the main intention here being merely the smoothing of the surface ground, for the purposes of pasturing or mowing; but the more the stony substances are covered with good earthy mould, the better and greater will be the quantity of produce. See *TILLAGES*.

There are many rough woody tracts of ground, of the shrubby or other kinds, which may be cleared and reclaimed with vast advantage to their proprietors, as well as the community in general, as corn-lands, or for other uses. The most usual method of accomplishing this sort of improvement has been to dig out the whole of the roots, whether of low woods or timber woods, at the time of removing the tops, so as to admit the plough immediately. In perform-

ing this in this way, however, where the stools are of the timber kind, numerous and large, deep breaking of the ground is often necessary, which is laborious and expensive; and rotten wood, mould, leaves, and other surface matters, are apt to be left in mixture with the infertile or poisonous sub-strata. As lands, cleared and reclaimed in this manner, have been known to remain in a *raw* unprofitable condition, for several years, although limed, dunged, and raised in sharp ridges, in order to its amelioration.

This improper practice has consequently been highly disadvantageous, injurious, and ruinous, and thrown much difficulty and interruption in the way of clearing and reclaiming such waste lands for the growth of corn, however suitable they may be for the purpose in the nature of their soils and situations, thereby tending to propagate and support the notion, that such sorts of land will not repay the expences and trouble of being improved.

But from attending to what has naturally happened to the cleared parts of wood-lands, it will be seen that a depth of fertile mould, resting on less fertile substances, form a regular soil and sub-soil, which are free from the roots of trees, ready to receive the plough, and afford corn crops in due succession. This is supposed to take place somewhat in this way. The trees having been suffered to become decayed, or more properly cut down in due season, and the brush or underwood cut and cleared away from time to time by the occupiers, while such commons or other places were fully or too much stocked with cattle and sheep, the young shoots were of course browsed off and nibbled away quite to the stumps, consequently weakened, and at length finally destroyed. The roots and other parts soon followed this course, and passed into a state of vegetable mould, increasing and enriching the soil at the same time. Nay, this may, in the natural state, it is supposed, be, in some measure, effected alone by the grazing animals, as it is essential to their existence.

This natural process, however assisted in this way, is slow, requiring a length of time for its completion; yet by proper means of art, well applied, it may be accomplished in a few years; the larger roots being extracted from the ground, instead of waiting for their reduction by a slow decay, without any unnecessary disturbance of the sub-soil; and then filling in the pits by the roughnesses of the natural surface: by which means the cleared ground will be smoothed, and made fit in due time for being cultivated. Where the surface is much incumbered with leaves and rotten woody matters, they are to be raked up, and put into heaps to decay; or they may be burnt, and the ashes spread out over the surface of the land. Proper draining and further levelling must likewise take place, where necessary; as well as harrowing or hacking the surface sward, so as to sow it with proper grass seeds; again raking off any rubbish that may arise, and then rolling the whole quite smooth for mowing. It should be stocked hard, especially with sheep, mowing off occasionally any woody shoots that may be permitted to arise; keeping the whole in the state of close pasturage, until the smaller roots, which were left, be so decayed as to become obedient to the plough-share. At this period, but not before, such pasture ground may be broken up for grain crops in proper succession.

The process might be hastened by the use of lime, or other calcareous matters in union with the vegetable substances which were removed, as they would be sooner dissolved or reduced, and the compost be more rich. And by spreading them out on the land a similar effect might be produced, and a finer sort of herbage be encouraged, which would cause a clover bite, and sooner bring the land into a

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more thick fet state of sward, which is the prolific matrix for corn crops.

The really necessary expence of reclaiming and bringing these kinds of wooded lands into a state of cultivation, by these means, is inconsiderable, particularly where fuel is dear. Where the timber wood is properly cut down by the axe, and the underwood taken off rather below the surface, the larger roots, and the stubs which are left, will, in some instances, more than repay the cost of the clearing and levelling the surface. And the other expences will be repaid by the immediate production of a pasture ground, the value of which is constantly increasing without any further charge, until it may probably be worth two or three times what the lands were while they were in the woody condition.

In cases where fuel is cheap, and particularly when the timber wood is rapidly fallen, as in the barking season, they may be cut off by the saw level with the surface of the land; the stools and large superficial roots being after that carefully disbarked to some inches within the ground, so as to prevent their throwing out shoots to injure the surface and keep the roots alive. In this way the stools will be so decayed in a few years as to be capable of being removed with little trouble or expence. See **TILLAGE**.

In clearing and reclaiming moory lands where they are too wet, the first step is that of properly draining them; they are afterwards brought into cultivation and to their full value by other means, such as in large undertakings, by suitable divisions of the lands into fields proper for the farm or farms to which they are to be laid, and so ditched as that the surface water may be effectually taken off, without having deep, open, expensive troublesome drains in other parts; the surface of each field being adjusted in such a manner as to shoot off the rain water into the intersecting ditches, in order to prevent injury from happening, in that way, so as to impede the cultivation for any length of time.

As the surfaces of these kinds of land are mostly rugged and uneven, as well as of a loose spongy texture, which unfits them for the tillage processes, without previous assistance from hand labour; where the moory earth, or vegetable mould, is deep, and rises to the surface uncovered by fossil matters, some length of time is requisite to bring it to that solidity and firmness of texture which is suited to the common arable purposes. Hence the general principle of improving deep moory lands, where there is no fossil covering, is supposed to be the same as that advised for bringing woodlands into cultivation; namely, that of converting them to a profitable state of herbage, before corn crops are attempted to be produced.

The process must be guided and regulated by the nature and situation of the tract to be improved. Where the surface is very irregular, full of inequalities, and of an abrupt nature, it must first be adjusted so as to admit the means of tillage when they can be properly had recourse to, and for carrying away the surface waters in the manner already noticed. Then to pare off the lesser hillocks and risings, as the tufts and haddock which were formed during its wet state, and more or less of its general surface, so as to remove the coarse plants and stale mould which occupy it, and thereby produce a freshness in the whole.

In dry seasons, when the surface has sufficient firmness to bear the tread of animals, the paring may be done by the plough for that purpose, but in other cases by the breast-plough or paring-spade. When the surface has been cut over in this manner, and any part has the appearance of being too wet, as may be judged of by the colour of the mould, in some degree, covered drains are to be formed in such places, which may commonly be made in a cheap and

durable manner by the firm fibrous tufts collected from the surface. The rest of the roots and mould which were pared off should be burnt, and their ashes spread evenly over the surface, being immediately raked or harrowed into the soil. At this period of the improvement almost any kind of fossil material can be thrown over the ashes at a little expence; and a full quantity of different grass seeds be covered in with it; leaving the surface to take on a sward without any further trouble or outlay of money.

Afterwards the grassy herbage is to be kept closely fed down when the weather will permit, first by sheep and then by heavier sorts of stock, until the surface becomes firm and the soil is well bound together by the fibrous roots of the herbage, so as to be capable of affording corn crops in proper succession.

It has been objected to this summary mode of bringing the land into the state of herbage, that there are no immediate gross returns for the money laid out in reclaiming and bringing it into the cultivable state. But although corn cannot be raised on such raw loose-textured sorts of land at first, potatoes are found to answer well, and rape with still more advantage in its culture, the labour attending it, and the profit which it affords. See *MOOR, MOORY-Land, SPRING and SURFACE Draining*, &c. See also the *Invernesshire Agricultural Report*.

The reclaiming and bringing lands of these several different descriptions into a state of cultivation and improvement is evidently a work of very great importance, particularly in a country where the population is getting too numerous for the produce, as by such means the extent of agricultural territory may be justly said to be increased. Extensive improvements of these kinds have lately taken place in Cornwall, and some other southern districts.

RECLAIMING Plantations and Timber Woods, in *Rural Economy*, the restoring of such as have grown into a wild, neglected, and improper state from some sort of mismanagement, or want of attention. The causes which have a tendency to produce this effect are very numerous, and have been the means of vast individual as well as national loss. One material and very frequent cause is the neglect of their boundary fences; another is the mistaken notion of its being the best practice to leave them entirely to nature after they are once properly planted; a third is the very absurd supposition, that nothing should be done to them for a length of time after planting, in the way of rendering the trees more thin among themselves, or in their branches; and lastly, an universal carelessness and disregard of them, frequently from the narrow conception of expence being incurred without the chance of any immediate return of profit. It is, on the whole, much too common to take great care in first forming the plantations, without ever thinking or taking any sort of interest in their after-management. But the business is by no means accomplished in the simple act or operation of planting out the trees. Good examples of this kind of management are indeed few, but they occasionally exist, and much has been written on the matter, so that information may be readily obtained. And there is every inducement to get it; as well prepared, inclosed, planted, cultivated and managed plantations, will far outgrow others that have existed for a much longer time, but have been otherwise treated, often affording more than woods of three times their length of standing.

In directing the proper management in all cases of this nature, some attention must be paid to the particular kinds of the plantation which they may be, in the first place; after which, the means of reducing them to their appropriate states, or to some other in the most easy and convenient manner,

manner, may be taken into consideration. It may often happen that their proper originally intended states cannot be attempted, but that which has been gradually acquired must be promoted. With a view to the accomplishment of those intentions, plantations may be considered as consisting either of hard woods only, of evergreen or resinous trees only, or of both these sorts of trees in mixture.

In the first of these kinds, or those which are composed solely of the hard-wooded sorts of trees and plants, where they are to be brought to the state of woods, as timber trees and undergrowths, and the latter to be used only as fuel, the good trees of such kinds as are suitable to the soil, and the probable demand of the vicinity and other parts, should be fixed upon, and left as standard trees; the whole of the others being cut over by the surface of the ground, so that they may become stools for supplying the undergrowths. When this has been performed, the ground, where necessary, should be dug, hoed, or trenched over, as circumstances may direct; but where the trees and underwoods have been much crowded, these kinds of work will seldom be required. However, if, instead of the common underwood, oak be required, then after pitching upon the most proper and suitable standard trees for remaining, the whole of the rest are to be taken up by the roots, the land dug over, and acorns planted out upon it; which, when they are grown up, must be kept clean and free from weeds for some years, in order to promote their healthy growths and rising to the state of young trees.

Where the whole is to be reduced to the state of copse wood for fuel only, the best way is to cut over every part by the surface of the ground; and when for bark, to root out the whole, only reserving the oaks, and planting with acorns, as already noticed.

In case the grove forms are to be produced, the most suitable and appropriate trees are to be left at proper distances, and the whole of the remainder taken out by the roots; after which the ground should have the proper culture, until the trees are incapable of being injured by cattle stock; at which time the whole may be laid down with natural grass seeds.

In the second sorts of plantations, where they have remained, after planting, without being in any way thinned, for a great many years, they are often, in a great measure, incapable of being remedied, as they are, for the most part, so overpowered by each other, that their growth is suspended; wherever any thinning takes place, the trees all around are destroyed. In these cases it is the advice of some to have the whole grubbed up by the roots and replanted, after the ground has been properly prepared by fallowing and repeated corn crops. But as there may sometimes be much loss in this way, it may be proper to try the cautious thinning of them, which should be done during the latter summer months in a careful manner, as success has occasionally attended this method.

With natural plantations of this kind under twenty years' growth, and artificial ones under ten, much advantage has been gained by suitable cautious thinning and retrenching. In all these cases there is no necessity whatever for the cultivation of the ground, as the trees suffer few or no plants to rise below them, and besides, injury may be done to their superficial roots.

The management in the last or mixed kinds of plantations, where the evergreen trees are in such proportions as not to admit of either of the above modes, is to reduce them to the grove plan only, or to this in some parts and the wood kind in others; the modes of accomplishing both of which have been already laid down. However, in each of

these methods, it will frequently happen that the tree or trees which are the most advantageous and desirable in the parts where the plantations exist, are either very deficient, or wholly wanting. In all such instances it is probably the best and most beneficial practice to grub up nearly the whole of such trees, and replant the ground with the proper sort or sorts; care being taken to leave such a number of the old trees, either in a scattered manner, or in narrow stripes and screens, for sheltering and protecting the young trees, plants, and seeds, which have been put in, planted, or sown. See PLANTATION and WOOD.

It may be noticed that in reclaiming all kinds of wild and neglected plantations in lands which are inclined to the retention of moisture; the first thing which is necessary is invariably that of the removal of the stagnant wetness, as where this is not properly performed, the other operations will be of but little avail, however well they may be executed. In many extensive tracts of this nature, the injury which is sustained by this sort of neglect is scarcely to be calculated. There are many thousands of acres, in different situations in this country, which would by this means alone be brought to twenty times and more their present value. And as this sort of work in such cases can, for the most part, be accomplished by open cuts or gutters alone, at a very trifling expence in comparison of that for arable and some other sorts of land, it should never be neglected where good management is in the least degree attended to. See SPRING and SURFACE Draining.

It is a material point in reclaiming all these sorts of plantations and timber woods, to keep the surrounding ditches and fences well up and in a proper safe state, as large tracts are often completely ruined in a very short time by inattention in this respect, from the cropping, rubbing, and destruction in other ways produced by the entrance of cattle of different kinds into them. There is hardly any thing so injurious to the more young timber plantations as cattle being suffered to get into them. See FENCE.

The retrenching of old ill-managed plantations of these kinds should constantly be done in a very gradual manner, having due regard to their length of standing, the nature of the trees, the quality of the land, the situation and exposure, as well as some other points. Their outside parts are in general to be left more thick and close, than those which are more in the interior, and the parts of the soil which are of a bad thin quality, should be left less thick of trees and plants than where it is of greater depth and richness. And open exposures should be kept more thick and close than where they are more warm and sheltered.

In retrenching the branches of the different trees, the work should be performed according to the length of time the trees have been growing, their particular growths and sizes, the difference of kind, and the uses, purposes, and intentions for which their wood or other parts are designed. It is always proper to stop rather short, than to carry it to an extreme, as there is sometimes danger in the latter case. See PRUNING.

It is always necessary and essential to reclaim these old wild sorts of plantations as soon as possible, as the forming of new tracts of this kind chiefly benefit posterity, while the ameliorating and improving of the other, by these means, are an immediate and direct gain to the present proprietors, of very great national importance at the present time, and which would otherwise be complete loss to both.

No sorts of woods of the timber kind should indeed ever be suffered to remain any great length of time without being properly looked over and put into such states as that they may go on in the most beneficial and profitable manner, as

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where they are in any way or by any means restricted or impeded in their growths, there is a constant and continual loss taking place, and the ultimate disadvantage is prodigiously great, as the timber never becomes either so good or in such quantity; of course it is of inferior value in both respects, which makes a difference of much consequence to the proprietors as well as to the nation at large. See **WOOD**.

RECLINATION of a *Plane*, in *Dialling*, the number of degrees which a dial-plane leans backwards, from an exactly upright or vertical plane, *i. e.* from the zenith.

The reclination is easily found, by means of a ruler, and a quadrant; for having drawn an horizontal line on the plane by a level or quadrant, and to it another line at right angles, apply a ruler, so that one end of it may hang over, or reach beyond the plane; then will a quadrant, applied to the under edge of the ruler, shew the degrees and minutes of the plane's reclination; counting from that side of the quadrant that is contiguous to the edge of the ruler.

RECLINATUM FOLIUM, in *Botany*, a leaf whose point is curved downwards, below the level of the base. See **LEAF**.

RECLINATUS CAULIS, a reclined stem, is bent towards the earth, as in many species of *Ficus*, *Salix*, *Rubus*, &c.

RECLINER, or **RECLINING Dial**, is a dial whose plane reclines from the perpendicular; *i. e.* leans from you when you stand before it.

When this reclination is equal to the height of the pole, the dial is said to be equinoctial. See **DIAL**.

RECLINER, *Declining*, or *Declining reclining dial*, is a dial which neither stands perpendicularly, nor opposite to one of the cardinal points. See **DIAL**.

RECLUSE, among *Religious*, a person close shut up in a very narrow cell of an hermitage, or other religious house; and cut off, not only from all conversation with the world, but even with the house.

The word is chiefly used for such as thus imprison themselves out of devotion, to do penance. It is sometimes also applied to incontinent wives, whom their husbands procure to be thus kept in a perpetual prison in some convent.

Recluses were anciently very numerous; they were then a kind of solitaries who shut themselves up in some little cell, with a vow never to stir out of it.

None were admitted to this oath until they had given sufficient proofs of their abstinence, and had leave from the bishop, or the abbot of the monastery where they were shut up; for the cells of the recluses were always to join to some monastery.

The prelate's permission being obtained, they were tried for a year in the monastery; out of which, during that time, they never stirred.

They were then admitted to their vow of stability in the church before the bishop; which being done, and the recluse having entered his little cell, the bishop set his seal on the door.

The cell was to be very small, and very exactly closed. The recluse was to have every thing within it necessary to life; and even, if he were a priest, an oratory consecrated by the bishop, with a window which looked into the church, through which he might make his offerings at the mass, hear the singing, sing himself with the community, and answer those who talked to him. But this window was to have curtains before it, both within and without; so that the recluse might neither see, nor be seen.

Indeed he was allowed a little garden in his reclusion, to plant a few herbs, and take fresh air; adjoining to his cell

was that of his disciples, which he was very rarely without; with a window, through which they served him with necessities, and received his instructions.

When it was judged proper to have two or three recluses together, their cells were made contiguous to each other with windows of communication; if any woman would consult them, or confess to them, it was to be in the church, and in the face of all the world.

Where there were two or three recluses together, they were never to hold any conference, but on spiritual matters, and to confess to each other; where there was but one, he was to confess and examine himself.

If the recluse fell sick, his door was opened for people to come in and assist him; but he was not allowed to stir out on any pretence whatever.

These articles are extracted from the rule, compiled for the recluses, by Grimlaic, a priest in the ninth century.

There were also women recluses, who led the same life, in proportion. St. Viborade lived a recluse at St. Gall, and was there martyred by the Hungarians in 825.

RECLUSION, the state of a recluse; or the cell and other appurtenances of it.

F. Helyot gives a particular account of the ceremonies practised in the reclusion of a woman, in that of mother de Cambray, institutrix of the order of the representation of Notre Dame. A cell being built for her in 1625, adjoining to the church of St. Andrew, in Tournay, the bishop waited for her early in the morning at the church-door. Upon her arrival, prostrating herself at the feet of that prelate, he gave her his benediction; conducted her to the grand altar; and there blessing a mantle, veil, and scapular, he put them on her, and gave her a new name.

Having here made her vow, and the bishop having liangued the people in praise of the new recluse, he conducted her processionally to her reclusion; the clergy all the way singing *Veni, sponsa Christi*, &c.

Here the bishop, blessing her afresh, consecrated the reclusion, and shut her up in perpetual confinement.

RECOGNISANCE. See **RECOGNIZANCE**.

RECOGNITION, **RECOGNITIO**, denotes an acknowledgment. The word is particularly used in our law-books, for the title of the first chapter of the stat. 1 Jac. I. by which the parliament acknowledged the crown of England, after the death of queen Elizabeth, to have rightfully descended to king James.

RECOGNITIONS of Clement, in *Ecclesiastical History*, a supposititious or apocryphal book, ascribed to St. Clement, but really composed by some learned and eloquent man in the second century. Rufinus, who translated the ten books of Recognitions out of Greek into Latin, in whose translation only we now have them, plainly supposes them to have been written by Clement of Rome; but that the copies, in his time, had been corrupted in some places. The first ecclesiastical writer who has mentioned this work is Origen, by whom it is cited twice; but he does not seem to have held it in high estimation. Eusebius, who is supposed to mention the Recognitions under the title of "The Acts of Peter," which made a part of them, rejects these, and owns no work for St. Clement, but his epistle to the Corinthians. Epiphanius mentions "The Travels of Peter" as written by Clement, but corrupted by the Ebionites, so that little was left that is genuine. St. Jerome's opinion of the works of Clement coincides with that of Eusebius. This book is, for a large part of it at least, says the learned Dr. Lardner, a fiction or romance, in which divers things concerning the Christian religion are represented in a philosophical manner, in order to render them more agreeable to the Greeks. It

is called the "Circuits," or "Travels and Acts of Peter," from its subject, as it contains an account of the apostle Peter's disputes with Simon Magus, and his discourses to other people, and his miracles. It is called the "Recognitions," from Clement's recognizing his father, and mother, and brethren, who had been long separated from each other.

Mr. Whiston, though he allows that this work was not written by Clement himself, supposes that it was the production of some of the hearers of Clement, and other companions of the apostles; but Dr. Lardner is of opinion, that it must be reckoned to be Clement's, or to be supposititious. With regard to the age of this work, Lardner farther adds, that the arguments here urged against Heathenism seem to imply, that the Christian was not yet the prevailing established religion. And the author often speaks of the power of Christians to heal diseases, and to expel demons, as if it was common in his time. That such gifts were enjoyed by many Christians in the second, and in the beginning of the third, century, we are assured by Irenæus, Tertullian, Origen, and others; after which time, or however after the end of the third century, they were not so common, if they did not quite cease. Mr. Whiston's opinion of this book is, that if it be not, in some sense or other, itself a sacred book, yet it ought certainly to be esteemed in the next degree to that of the really sacred books of the New Testament. But in the opinion of many other learned men, it is a worthless piece, of little or no use. It contains, however, as Dr. Lardner suggests, some excellent sentiments, and fine passages, intermixed with very great faults, for which no excuse can be made. This book contains passages of our four gospels, though it has been doubted whether he used the four, or some one gospel containing in it all these. Its author seems to own the first epistle of St. John, and the book of the Revelation. He was also well acquainted with the book of the Acts of the Apostles; but it is not certain how far he owned it. The passages from St. Paul's epistles are not sufficient to prove, that they were esteemed by this writer to be of authority. The author does not seem, indeed, to have any great kindness for the apostle Paul, and on this account he made little use of his epistles, and of the Acts of the Apostles. From his sly insinuations, and injurious reflections upon St. Paul, it may be suspected that he was a mere Ebionite; the ancients assuring us, that this sect of Christians rejected the authority of that apostle and his epistles. The author bears testimony to many principal facts of the New Testament. He gives an account of our Lord's temptation; he mentions the choice of the 12 apostles, and afterwards of other 72 disciples. In one place he speaks of the 12 apostles in such a manner as if he intended to exclude Paul from the honour of the apostleship, and even to deny him the character of a sufficient and faithful "preacher of Christ's word." We have also, in this book, relations of the miracles of our blessed Lord's ministry, and of his death and resurrection, and the extraordinary signs attending these events. Grabe's Preface to the Writings of St. Clement in his "Spicilegium." Coteler apud Patr. Apost. tom. i. p. 484. Lardner's Works, vol. ii. p. 342, &c. See CLEMENTINE HOMILIES.

RECOGNITION, in the *Drama*. See DISCOVERY.

RECOGNITIONE *adnullanda per vim et duritiem facta*, in *Law*, is a writ to the justices of the common bench for sending a record touching a recognizance, which the recognizer suggests to have been acknowledged by force and hard dealing; that, if it so appear, it may be annulled.

Transcriptio Recognitionis facta coram iustitiariis itinerantibus. See TRANSCRIPTIO.

RECOGNITORS, RECOGNITORES. The jury impanelled upon an assize are called recognitors, because they acknowledge a disseisin by their verdict.

RECOGNIZANCE, or RECOGNISANCE, a bond or obligation of record acknowledged to the king; testifying the recognizer to owe to the recognizee a certain sum of money; with condition to do some particular act, as to appear at the assizes, to keep the peace, to pay a debt, or the like.

It is thus called, because recognized, or acknowledged in some court of record, or before some judge, master in chancery, or justice of the peace.

It is, in most respects, like another bond; the difference being chiefly this: that the bond is the creation of a fresh debt or obligation *de novo*, whereas the recognizance is an acknowledgment of a former debt upon record; the form of which is "A. B. doth acknowledge to our lord the king, to the plaintiff, to C. D., or the like, the sum of ten pounds," with condition to be void on performance of the thing stipulated; in which case the king, the plaintiff, C. D., &c. is called the "cognizee," *is cui cognoscitur*, or recognizee, as he that enters into the recognizance is called the "cognizor," or recognizer, *is qui cognoscit*. This, being either certified to, or taken by the officer of some court, is witnessed only by the record of that court, and not by the party's seal; so that it is not in strict propriety a deed, though the effects of it are greater than a common obligation; being allowed a priority in point of payment, and binding the lands of the cognizor, from the time of enrolment on record. Stat. 29 Car. II. c. 3.

There are also recognizances for *bail* (which see), others for appearing at the sessions to prosecute a felon, others for good behaviour, &c. See GOOD ABEARING.

There are also other recognizances of a private kind, in nature of a *STATUTE Staple*, (which see,) by virtue of the statute 23 Hen. VIII. cap. 6. which are a charge upon real property. This recognizance is a security, acknowledged before either of the chief justices, or (out of term) before their substitutes, the mayor of the staple at Westminster, and the recorder of London: by which the benefit of their mercantile transactions is extended to all the king's subjects in general by the above cited statute 23 Hen. VIII. c. 6. amended by 8 Geo. I. c. 25, which direct such recognizances to be enrolled and certified into chancery. But these, by the statute of frauds, 29 Car. II. c. 3. are only binding upon the lands in the hands of *bonâ fide* purchasers, from the day of their enrolment, which is ordered to be marked upon the record.

RECOGNIZANCE is also used, in our *Ancient Statutes*, for the verdict of the twelve jurors impanelled upon an assize; hence called *recognitors*.

RECOGNIZEE, or COGNIZEE, is he to whom one is bound in a recognizance. He that is so bound is called *recognizor*.

RECOIL, or REBOUND, the refilition of a body, chiefly a fire-arm; or the motion by which, upon explosion, it starts or flies backwards; the cause of which is the impelling force of the powder, which acts equally on the breech and on the ball; so that if the piece and ball were of equal weight, and other circumstances the same, the piece would recoil with the same velocity as that with which the ball is discharged; but the heavier any body is, the less will its velocity be, when the force impelling it continues the same. Therefore so many times as the cannon and carriages are heavier than the ball, just as many times will the velocity of the cannon be less than that of the ball; and the space through which the cannon recoils whilst the ball moves

along the cylinder, is to the length of the cannon diminished by the space behind the ball, as the weight of the ball is to the weight of the cannon. Let a twenty-four pounder of ten feet be 6400 pounds weight, and when the ball quits the piece, the cannon will have recoiled $\frac{24}{6400} \times 10 = \frac{3}{80}$ of a foot, less than half an inch.

The greater the charge, *ceteris paribus*, the greater the rebound. By an experiment made before the Royal Society, and related in the Philosophical Transactions, it was found, that cannons, charged to a certain degree, throw the ball from right to left of their own direction; but that the cannons themselves recoil from left to right.

Some of the gentlemen of the French academy doubting the justness of the observation, M. Cassini, the younger, undertook to repeat the experiment; which he did by means of a machine, as like that used in England as he could: and that tried over and over again.

The result was, that the ball, when the gun had liberty to recoil, was always thrown to the right of the point to which it was thrown when the gun was fixed without a possibility of rebounding; but then the recoil was always made the same way, *viz.* to the right; and he never found that contrariety of directions between the ball and the rebound, observed in the English experiment. See Hist. Acad. R. Scienc. A. 1703. p. 120, &c.

The cause of the phenomenon seems very difficult to assign; for supposing the guns of a common make, with the touch-hole on the top, we cannot so much as guess what cause should constantly determine the ball from right to left; unless some very material circumstances be omitted in the recital they have given us in the experiment.

Guns whose vents are a little forward in the chase recoil most. To lessen the recoil of a gun, the platforms are generally made sloping towards the embrasures of the battery. See PROJECTILES.

RECOLATION, a method of fining the decoctions of vegetables, &c. by repeated percolation, or straining them several times successively through a linen or woollen-bag.

RECOLLECTION, a mode of thinking, by which those ideas, sought after by the mind, are with pain and endeavour found, and brought again to view. See MEMORY and IMAGINATION.

RECOLLETS, a congregation of reformed Franciscans, called also *friers minor of St. Francis, of the strict observance*. They were established about the year 1532, when some religious of the order of St. Francis being willing to keep his rule to the letter, Clement VII. gave them houses, whither they might retire, and receive such as were disposed to follow them. The same year he approved the reform; and in 1584 it was carried from Italy into France, where these religious had already been established, in the towns of Tullés in Limousin, and Murat in Auvergne. They had a convent at Paris in 1603; and since they have erected no less than a hundred and fifty in the whole kingdom, where they are divided into seven provinces.

RECOLOGNE, in *Geography*, a town of France, in the department of the Doubs; eight miles W. of Besançon.

RECOMMENDATI. See AFFIDAVIT.

RECOMMENDATION, in a *Military Sense*, denotes a certificate, stating an individual to be properly qualified for a situation in the army. This certificate must be signed by a field-officer in the regulars, addressed to the commanding officer of the regiment, by whom it is forwarded to the commander-in-chief, who lays the name of the person recommended before the king.

RECOMPOSITION, in *Chemistry*, the compounding of bodies from their separated parts, or principles, so as to compose the original whole again. This is extremely difficult to effect universally, but in some cases it may be done, and that so perfectly, that the recomposed body shall not be distinguishable by the senses from that which had never been separated by the fire. If the art of chemistry were perfect, we should thus be able, at least in some degree, to recompose all the bodies we divide; but this is far from being the case at present. We can by no means do this in vegetable and animal bodies, where there is a vascular structure, and therefore we are carefully to distinguish between the regeneration of organized, and that of unorganized bodies.

RECONCILIARI, in our *Law Books*, &c. A church is said *reconciliari*, to be reconciled, when it is consecrated afresh, after having been polluted or profaned; as by the possession of pagans, heretics, &c.

RECONCILIATION of Penitents, in *Church History*, See POENITENTES.

RECONNOITRE, in *War*, implies to view and examine the state of things, in order to make a report of them.

The word is French, signifying, literally, *to know, recollect*.

We say to reconnoitre the coasts, to reconnoitre a port, &c. A body of horse was sent to reconnoitre their camp, the ground, the condition of the roads, rivers, &c.

Parties ordered to reconnoitre, are to observe the country and the enemy; to remark the routes, conveniencies, and inconveniencies of the first; the position, march, or forces of the second. In either case, they should have an expert geographer, capable of taking plans readily; he should be the best mounted of the whole, that in case the enemy happen to scatter the escort, he may save his works and ideas.

All parties that go for reconnoitring only, should be but few in number: never more than twelve or twenty men. An officer, be his rank what it will, cannot decline going with so few under his command: the honour is amply made up by the importance of the expedition, frequently of the most interesting consequence, and the properest to recommend the prudence, bravery, and address of any officer that has the fortune to succeed.

It is previously necessary that the officer ordered on this duty should be well acquainted with the country, the roads, and the distance of the enemy. His party must consist of men of approved fidelity, part of whom should be disguised. This detachment must march off in the night. The men must have strict orders neither to smoke tobacco, make a noise, nor speak. The officer must be provided with two guides, who are to be strictly interrogated, but are to remain ignorant of the route you intend to take. A detachment of this kind should be furnished with subsistence for two or three days. The horses are to be fed every two or three leagues, for it is absolutely necessary that they should be always fresh and fit for duty. The officer will take care never to halt, but at a distance from any road, and also take every precaution to prevent his being surprised, whilst his horses are feeding, &c.

RECONNOITRE is also used at sea. To reconnoitre a vessel, a fleet, &c. is to approach near enough to examine the rate and burden of a vessel, &c. the force it may have aboard, what nation it is of, &c.

To reconnoitre a land, or shore, is to observe its situation, in order to find what land it is.

RECORD, RECORDIUM, in *Law*, an authentic testimony of any thing in writing, contained in rolls of parchment, and preserved in a court of record. See COURT, and CUSTOM.

Records

Records are said to be *vetustatis & veritatis vestigia*. So early as the Conquest we find the "*prætoriorum memoria eventorum*" reckoned up as one of the chief qualifications of those who were held to be "*legibus patriæ optimè instituti*." For it is an established rule to abide by former precedents, where the same points come again in litigation; as well to keep the scale of justice even and steady, and not liable to waver with every new judge's opinion, as also because the law in that case being solemnly declared and determined, what before was uncertain, and perhaps indifferent, is now become a permanent rule, which it is not in the breast of any subsequent judge to alter or vary from, according to his private sentiments: he being sworn to determine not according to his own private judgment, but according to the known law and custom of the land; not delegated to pronounce a new law, but to maintain and expound the old one. Yet this rule admits of exception, where the former determination is most evidently contrary to reason; much more if it be clearly contrary to the divine law. But even in such cases the subsequent judges do not pretend to make a new law, but to vindicate the old one from misrepresentation. For if it be found that the former decision is manifestly absurd or unjust, it is declared, not that such a sentence was *bad law*, but that it was *not law*, that is, that it is not the established custom of the realm, as has been erroneously determined. An act committed to writing in any of the king's courts, during the term in which it is written, is alterable, being no record; but that term once ended, and the act inrolled, it is a record, and of such credit as admits no alteration, or proof to the contrary.

It is a settled rule and maxim that nothing shall be averred against a record (see COURT,) nor shall any plea, or even proof, be admitted to the contrary. (Co. Litt. 260.) And if the existence of a record be denied, it shall be tried by nothing but itself; that is, upon bare inspection whether there be any such record or no; else there would be no end of disputes. But if there appears any mistake of the clerk in making up such record, the court will direct him to amend it. Courts of record, or repositories for the public records of the kingdom, were first established by Edward I., our English Justinian, some of which are more ancient than the reign of his father, and those were by him collected.

Lawyers reckon three sorts of records; *viz.* a *judicial* record, as attainer, &c.; a *ministerial* record upon oath, as an office of inquisition found; and a record made by *conveyance* and consent, as a fine, or deed inrolled, and the like.

RECORD, *Affurances by matter of*, are such as do not entirely depend on the act or consent of the parties themselves; but the sanction of a court of record is called in, to substantiate, preserve, and be a perpetual testimony of the transfer of property from one man to another; or of its establishment, when already transferred: of this nature are private acts of parliament, the king's grants, fines, and common recoveries.

RECORD, *Court of*. See RECORD, *supra*, and COURT.

RECORD, *Debt of*, is a sum of money, which appears to be due by the evidence of a court of record. Thus, when a specific sum is adjudged to be due from the defendant to the plaintiff, on an action or suit at law, this is a contract of the highest nature, being established by the sentence of a court of judicature. Debts upon recognizances, together with statutes merchant, and statutes staple, &c. if forfeited by non-performance of the condition, are also debts of record; the contract, on which they are founded, being witnessed by the highest kind of evidence, *viz.* by matter of record.

RECORDS, *Imbezelling of*. See IMBEZZLE.

RECORD, *matter, must, over, prisoner upon matter of*, see MATTER, MUSTER, OVER, and PRISONER, &c.

RECORD, *Trial by*, is used only in one particular instance; where a matter of record is pleaded in any action, as a fine, a judgment, or the like; and the opposite party pleads "*null tiel record*," that is, there is no such matter of record existing: upon this, issue is tendered and joined in the following form, "and this he prays may be enquired of by the record, and the other doth the like;" and hereupon the party pleading the record has a day given him to bring it in, and proclamation is made in court for him "to bring forth his record, or he shall be condemned:" and, on his failure, his antagonist shall have judgment to recover. The trial of this issue is, therefore, merely by the record; for, as Sir Edward Coke observes (1 Inst. 117. 260.), a record or enrolment is a monument of so high a nature, and importeth in itself such absolute verity, that if it be pleaded there is no such record, it shall not receive any trial by witness, jury, or otherwise, but only by itself. Thus, titles of nobility shall be tried by the king's writ or patent only, which is matter of record. (6 Rep. 53.) Also in case of an alien, whether alien, friend, or enemy, shall be tried by the league or treaty between his sovereign and ours; for every league or treaty is of record. (9 Rep. 31.) And also whether a manor be held in ancient demesne or not, shall be tried by the record of Domesday in the king's exchequer. Blackst. Com. book iii.

RECORD, among *Fowlers*. A bird is said to record, when it begins to tune or sing within itself; or to form its notes and dispose its organs for singing.

The cock thrush is distinguished from the hen in recording; the first being more loud and frequent in it than the second.

Instances have been known of birds beginning to record when they were not a month old. This first essay does not seem to have the least rudiments of the future song; but as the bird grows older and stronger, one may perceive what the nestling is aiming at. A young bird commonly continues to record for ten or eleven months, when he is able to execute every part of his song, which afterwards continues fixed, and is scarcely ever altered. The term record is probably derived from a musical instrument, formerly used in England, called a *recorder*, which seems to have been a species of flute, and was probably used to teach young birds to pipe tunes. Lord Bacon describes this instrument (in his second Century of Experiments) to have been straight, to have had a lesser and greater bore, both above and below, to have required very little breath from the blower, and to have had what he calls a sipple or stopper.

RECORDARI *facias loquelam*, in *Law*, a writ directed to the sheriff to remove a cause depending in an inferior court, as hundred-court, county-court, court of ancient demesne, &c. to the king's bench, or common pleas, &c.

It is thus called, because it commands the sheriff to *make a record* of the proceedings either by himself, or others; and then to send up the cause.

RECORDE, ROBERT, in *Biography*, an early English physician, of Welsh origin, commenced his education at Oxford about the year 1525; and in 1531 was elected fellow of All-Souls' College. Directing his studies to physic, but where, or under what masters, we are not told, he was created doctor in that faculty at Cambridge in 1545. Both before and after this period he is said to have taught arithmetic at Oxford, and to have excelled all his predecessors

sors in rendering this branch of knowledge clear and familiar. He is likewise mentioned as remarkably skilled in rhetoric, astronomy, geometry, music, mineralogy, and every part of natural history. He was well acquainted with the Saxon language, and made large collections of historical and other ancient manuscripts. To these various studies he joined that of divinity, and was attached to the principles of the Reformers. But notwithstanding he was justly deemed a prodigy of learning and talents, it does not appear that he met with encouragement at all adequate to his merits; since all that we know further of him is, that he died in the king's bench prison, where he was confined for debt, in the year 1558.

He was author of several works, some of which were several times reprinted, on the following subjects.

"The Ground of Arts, teaching the Work and Practice of Arithmetic, both in whole Numbers and Fractions," 1540. This was dedicated to king Edward VI. "The Whetstone of Wit," a second part of the former. "The Path-way to Knowledge, containing the first Principles of Geometry." "The Cattle of Knowledge, containing the Explanation of the Sphere." "The Urinal of Physick," 1547, which was reprinted in London in 1582, 1599, and 1665; and in the last mentioned year, the title of "The Judicial of Urines" was given to it. This book contains a description of urinary vessels with figures. It is a short, but very methodical treatise, full of divisions and subdivisions relative to the different kinds of urines, and the prognostics to be deduced from them. Nevertheless he candidly acknowledges at the beginning, that the judgment to be formed in diseases from the urine is not so certain as some have represented; and indeed the perplexity and variety of opinions concerning this subject are sufficiently apparent from his treatise. His other works were, "Of Anatomy;" "Of Auricular Confession;" "Of the Eucharist;" and "The Image of a true Commonwealth." Aikin's Biog. Memoirs of Medicine.

RECORDER, RECORDATOR, a person whom the mayor, or other chief magistrate of any city, or town corporate, having jurisdiction, and a court of record, within their precincts, does associate with him, for his better direction in matters of justice, and proceedings according to law. He is usually a counsellor, or other person, versed and experienced in the law. In some towns, which have their particular assizes within themselves, and no mayor, the recorder is the judge.

The recorder of London is one of the justices of oyer and terminer, and a justice of peace of the quorum, for putting the laws in execution for preserving the peace and government of the city; and being the mouth of the city, he delivers the sentences and judgments of the courts therein, and also certifies and records the city customs, &c. He is chosen by the lord mayor and aldermen, and attends the business of the city, on any warning by the lord mayor, &c.

RECORDER, in Music. See **RECORD**, supra.

RECORDO & processu mittendis, in Law, is a writ to call a record, together with the whole proceedings in the cause, out of an inferior court into the king's court.

RECOVERY, in a legal sense, an obtaining of any thing by judgment, or trial at law; answering to *evictio* among the civilians.

There is a *true* and a *feigned* recovery.

RECOVERY, True, is an actual or real recovery of any thing, or of the value of it, by judgment. As if a man sue for any land, or other thing, and have a verdict or judgment for him.

RECOVERY, Feigned or Common, is a sort of *fictio juris*, being a certain form or course prescribed by law to be observed for the better assuring of lands and tenements to us; the end and effect of which is, to discontinue and destroy estates-tail, remainders, and reversions, and to bar the entails of them.

These common recoveries were invented by the ecclesiastics to elude the statutes of mortmain; and afterwards encouraged by the finess of the courts of law in 12 Edw. IV. in order to put an end to all fettered inheritances, and bar not only estates-tail, but also all remainders and reversions expectant thereon.

A common recovery is so far like a *fine* (which see), that it is a suit or action, either actual or fictitious; and in it the lands are *recovered* against the tenant of the freehold; which recovery, being a supposed adjudication of the right, binds all persons, and vests a free and absolute fee-simple in the recoveror.

This recovery is either with a *single* or *double voucher*; and sometimes a treble or farther voucher, as the exigency of the case may require.

As a recovery is in the nature of an action at law, not immediately compromised like a *fine*, but carried through every regular stage of proceeding, its form and method are not easily understood by those who are unacquainted with the course of judicial proceedings. Judge Blackstone has, therefore, stated its nature and progress as clearly and concisely as possible; avoiding, to the utmost of his power, all technical terms and phrases not before interpreted. Of his luminous statement we shall avail ourselves in the sequel of this article.

Let us (says he), in the first place, suppose David Edwards to be tenant of the freehold, and desirous to suffer a common recovery, in order to bar all entails, remainders, and reversions, and to convey the same in fee-simple to Francis Golding. To effect this, Golding is to bring an action against him for the lands; and he accordingly sues out a writ, called a *præcipe quod reddat*, because those were its initial or most operative words, when the law proceedings were in Latin. In this writ the demandant, Golding, alleges, that the defendant, Edwards, (here called the tenant) has no legal title to the land; but that he came into possession of it after one Hugh Hunt had turned the demandant out of it. The subsequent proceedings are made up into a record or recovery roll, in which the writ and complaint of the demandant are first recited; whereupon the tenant appears, and calls upon one Jacob Morland, who is supposed, at the original purchase, to have warranted the title to the tenant; and thereupon he prays, that the said Jacob Morland may be called in to defend the title, which he so warranted. This is called the *voucher*, *vocatio*, or calling of Jacob Morland to warranty; and Morland is called the *vouchee*. Upon this, Jacob Morland, the vouchee, appears, is impleaded, and defends the title. Whereupon Golding, the demandant, desires leave of the court to *imparl*, or confer with the vouchee in private; which is (as usual) allowed him. And soon afterwards the demandant, Golding, returns to court, but Morland the vouchee disappears, or makes the default. Whereupon judgment is given for the demandant, Golding, now called the recoveror, to recover the lands in question against the tenant, Edwards, who is now the recoveree: and Edwards has judgment to recover of Jacob Morland lands of equal value, in recompense for the lands so warranted by him, and now lost by his default; which is agreeable to the doctrine of warranty. This is called the recompense, or *recovery in value*. But Jacob Morland having no lands of his own, being usually the cryer of the court

RECOVERY.

court (who, from being frequently thus vouched, is called the *common vouchee*) it is plain that Edwards has only a nominal recompense for the lands so recovered against him by Golding; which lands are now absolutely vested in the said recoveror by judgment of law, and seisin thereof is delivered by the sheriff of the county. So that this collusive recovery operates merely in the nature of a conveyance in fee-simple, from Edwards the tenant in tail, to Golding the purchaser.

The recovery, here described, is with a single voucher only; but sometimes it is with *double, treble*, or farther voucher, as the exigency of the case may require. And indeed it is now usual always to have a recovery with double voucher at the least: by first conveying an estate of freehold to any indifferent person, against whom the *præcipe* is brought; and then he vouches the tenant in tail, who vouches over the common vouchee. For, if a recovery be had immediately against tenant in tail, it bars only such estate in the premises of which he is then actually seised; whereas if the recovery be had against another person, and the tenant in tail be vouched, it bars every latent right and interest which he may have in the lands recovered. If Edwards therefore be tenant of the freehold in possession, and John Barker be tenant in tail in remainder, here Edwards doth first vouch Barker, and then Barker vouches Jacob Morland the common vouchee; who is always the last person vouched, and always makes default: whereby the demandant, Golding, recovers the land against the tenant Edwards, and Edwards recovers a recompense of equal value against Barker the first vouchee; who recovers the like against Morland the common vouchee, against whom such ideal recovery in value is always ultimately awarded.

This supposed recompense in value is the reason why the issue in tail is held to be barred by a common recovery. For if the recoveree should obtain a recompense in lands from the common vouchee (which there is a possibility in contemplation of law, though a very improbable one, of his doing) these lands would supply the place of those so recovered from him by collusion, and would descend to the issue in tail. This reason will also hold with equal force, as to *most* remainder-men and reversioners; to whom the possibility will remain and revert, as a full recompense for the reality, which they were otherwise entitled to: but it will not *always* hold; and therefore, as Pigott says, the judges have been even *astuti*, in inventing other reasons to maintain the authority of recoveries. And, in particular, it hath been said, that, though the estate-tail is gone from the recoveree, yet it is not *destroyed*, but only *transferred*; and still subsists, and will ever continue to subsist (by construction of law) in the recoveror, his heirs, and assigns: and, as the estate-tail so continues to subsist for ever, the remainders or reversioners expectant on the determination of such estate-tail can never take place.

To such awkward shifts, such subtle refinements, and such strange reasoning, were our ancestors obliged to have recourse, in order to get the better of that stubborn statute *de donis*. The design, for which these contrivances were fet on foot, was certainly laudable; the unrivetting the fetters of estates-tail, which were attended with a legion of mischiefs to the commonwealth: but, while we applaud the end, we cannot but admire the means. Our modern courts of justice have indeed adopted a more manly way of treating the subject; by considering common recoveries in no other light, than as the formal mode of conveyance, by which tenant in tail is enabled to aliene his lands. But, since the ill consequences of fettered inheritances are now generally seen and allowed, and of course the utility and expedience

of setting them at liberty are apparent; it hath often been wished, that the process of this conveyance was shortened, and rendered less subject to niceties, by either totally repealing the statute *de donis*; which perhaps, by reviving the old doctrine of conditional fees, might give birth to many litigations: or by vesting in every tenant in tail of full age the same absolute fee-simple at once, which now he may obtain whenever he pleases, by the collusive fiction of a common recovery; though this might possibly bear hard upon those in remainder or reversion, by abridging the chances they would otherwise frequently have, as no recovery can be suffered in the intervals between term and term, which sometimes continue for near five months together: or, lastly, by empowering the tenant in tail to bar the estate-tail by a solemn deed, to be made in term time and enrolled in some court of record; which is liable to neither of the other objections, and is warranted not only by the usage of our American colonies, and the decisions of our own courts of justice, which allow a tenant in tail (without fine or recovery) to appoint his estate to any charitable use, but also by the precedent of the statute 21 Jac. I. c. 19. which, in case of a bankrupt tenant in tail, empowers his commissioners to sell the estate at any time, by deed indented and enrolled. And if, in so national a concern, the emoluments of the officers, concerned in passing recoveries, are thought to be worthy attention, those might be provided for in the fees to be paid upon each enrolment.

The *force and effect* of common recoveries may appear, from what has been said, to be an absolute bar not only of all estates-tail, but of remainders and reversioners expectant on the determination of such estates. So that a tenant in tail may, by this method of assurance, convey the lands held in tail to the recoveror, his heirs and assigns, absolutely free and discharged of all conditions and limitations in tail, and of all remainders and reversioners. But, by statute 34 and 35 Hen. VIII. c. 20. no recovery had against tenant in tail, of the king's gift, whereof the remainder or reversion is in the king, shall bar such estate-tail, or the remainder or reversion of the crown. And by the statute 11 Hen. VII. c. 20. no woman, after her husband's death, shall suffer a recovery of lands settled on her by her husband, or settled on her husband and her by any of his ancestors. And by statute 14 Eliz. c. 8. no tenant for life, of any sort, can suffer a recovery, so as to bind them in remainder or reversion. For which reason, if there be tenant for life, with remainder in tail, and other remainders over, and the tenant for life is desirous to suffer a valid recovery; either he, or the tenant to the *præcipe* by him made, must *vouch* the remainder-man in tail, otherwise the recovery is void: but if he does vouch such remainder-man, and he appears and vouches the common vouchee, it is then good; for if a man be vouched and appears, and suffers the recovery to be had against the tenant to the *præcipe*, it is as effectual to bar the estate-tail as if he himself were the recoveree. Salk. 571.

In all recoveries it is necessary that the recoveree, or tenant to the *præcipe*, as he is usually called, be actually seised of the freehold, else the recovery is void. (Pigott, 28.) For all actions to recover the seisin of lands, must be brought against the actual tenant of the freehold, else the suit will lose its effect; since the freehold cannot be recovered of him who has it not. And, though these recoveries are in themselves fabulous and fictitious, yet it is necessary that there be *actores fabula*, properly qualified. But the nicety thought by some modern practitioners to be requisite in conveying the legal freehold, in order

to make a good tenant to the *præcipe*, is removed by the provisions of the statute 14 Geo. II. c. 20. which enacts, with a retrospect and conformity to the ancient rule of law, that, though the legal freehold be vested in lessees, yet those who are entitled to the next freehold estate in remainder or reversion may make a good tenant to the *præcipe*;—that, though the deed or fine which creates such tenant be subsequent to the judgment of recovery, yet, if it be in the same term, the recovery shall be valid in law;—and that, though the recovery itself do not appear to be entered, or be not regularly entered, on record, yet the deed to make a tenant to the *præcipe*, and declare the uses of the recovery, shall after a possession of twenty years be sufficient evidence, on behalf of a purchaser for valuable consideration, that such recovery was duly suffered. And this may suffice to give the student a general idea of common recoveries, the last species of assurances by matter of record.

For an account of deeds to lead, or declare, the *uses* of fines, and recoveries; see *USES*.

In some manors, by special custom, recoveries may be suffered of copyhold (Moor, 637.); but as these differ in nothing material from recoveries of free land, excepting only that they are not suffered in the king's courts, but in the court baron of the manor, we shall refer this subject to the article *SURRENDER*. In this place we shall observe, however, that a fine or recovery had of copyhold lands in the king's court may, if not duly reversed, alter the tenure of the lands, and convert them into frank-fee, which is defined in the old book of tenures to be "land pleadable at the common law:" but upon an action on the case, in the nature of a writ of "deceit," brought by the lord in the king's court, such fine or recovery will be reversed, the lord will recover his jurisdiction, and the lands will be restored to their former state of copyhold. Blackst. Com. b. ii.

Clerk of Inrolments of Recoveries and Fines. See *CLERK*.

RECOVERY, Fort, in *Geography*, a fort of America, in the Indiana territory, situated on a branch of the Wabash river, about 23 miles from Greenville. It consists of two block-houses, and barracks with curtains, sufficient for 60 men.

RECOUPE, French; formed of *re*, and *couper*, to cut again, in *Law*, to rebate, or discount.

Thus, if a man have ten pounds issuing out of certain lands, and he disseises the tenant of the land; in an assize brought by the disseisee, if he recover the land and damages, the disseisor shall recoupe the rent due in the damages.

RECOUPE also denotes a quick, sharp reply, to a peremptory demand. See *REPARTEE*.

RECREANT, in our old *Law-Books*, implies cowardly, faint-hearted.

Hence *recreantise*. See *CRAVEN* and *CHAMPION*.

Recreant was so reproachful a word, that Glanville would not describe it. *Recreantes equi* is used by Fleta, lib. ii. cap. 2. for dull, jaded horses.

RECREATION ISLAND, in *Geography*, a fertile island in the Southern Pacific ocean, discovered by Roggewin in the year 1722. Some of the ship's company obtained a quantity of antiseptic herbs; but upon venturing into the country, they were assaulted by the natives, who, by casting stones at them, killed some, and wounded almost all. Many of the islanders were killed by the fire-arms in return. The soil produces sugar-canes, cocoa-nuts, pomegranates, Indian figs, &c. The inhabitants were well made, robust, and very lively: their bodies were painted, and they were armed. S. lat. 16°. W. long. 148°.

RECREMENT, RECREMENTUM, in *Medicine*, some

superfluous matter separated from some other that is useful.

In which sense, it amounts to much the same with *fæces*, or excrement.

Recrements of vegetables are useful as manure.

RECREMENT is sometimes also used to denote such secreted juices in the body, as are afterwards of use in the economy; as the lymphæ, gall, &c. which are thus called, in contradistinction to excrements, which are expelled out of the body, as of no farther use.

RECRIMINATION, a posterior accusation brought by the accused against his accuser, upon the same fact.

When two parties have made their mutual complaint at the same time; the business is, first, to determine who shall be the accuser, and who the accused, *i. e.* on whom shall fall the recrimination.

By the French laws, recrimination is of no force till the criminal hath been purged legally.

RECRUDESCENCE, RECRUDESCENTIA, in *Medicine*, is a relapse, when a disease that has gone off returns again.

RECRUITS, in the *Military Art*, new men raised to supply the places of such as have lost their lives in the service, or are rendered unserviceable by age or wounds. See *LISTING*.

RECRUIT-Horses, are the horses brought up for completing the regiments of horse or dragoons every year.

RECTANGLE, in *Geometry*, called also *oblong*, and *long square*, a quadrilateral rectangular figure MLIK, (Plate XII. *Geometry*, fig. 3.) whose opposite sides, ML and IK, as well as MI and LK, are equal.

Or, a rectangle is a parallelogram, whose sides are unequal, but its angles right.

To find the area of a rectangle, see *PARALLELOGRAM*.

If from the same point A, (fig. 4.) be drawn two lines, one of which, AD, is a tangent to a circle, the other a secant AB; the square of the tangent AD will be equal to the rectangle under the secant AB, and that part of it without the circle AC. If two or more secants, Aa, AB, &c. be drawn from the same point A; the rectangles, under their wholes, and their parts without the circle, will be equal. If two chords intersect each other, the rectangles under their segments will be equal. The rectangles under equal lines are equal. The sum of all the rectangles contained under a given line, and all the parts of another any how divided, is equal to the rectangle contained under the two whole lines. If from any point, within a rectangle, to the angles of a rectangle, four lines be drawn, the sums of the squares of those drawn to the opposite angles will be equal. The rectangles contained under the corresponding sides of equiangular triangles, taken alternately, are equal. The rectangle under the two sides of any triangle is equal to the rectangle under the perpendicular to its base, and the diameter of the circumscribing circle. The square of a line bisecting any angle of a triangle, and terminating in the opposite side, together with the rectangle under the two segments of that side, is equal to the rectangle of the two sides, including the proposed angle. The rectangle of the two diagonals of any quadrilateral inscribed in a circle, is equal to the sum of the two rectangles contained under the opposite sides.

RECTANGLES, Similar. See *SIMILAR*.

RECTANGLE, in *Arithmetic*, is the same with product or factum.

RECTANGLED, RIGHT-ANGLED, Triangle, is a triangle, one of whose angles is right, or equal to 90°. See *TRIANGLE*.

There can be but one right angle in a plain triangle; therefore a rectangled triangle cannot be equilateral.

RECTANGULAR, in *Geometry*, is applied to figures and solids which have one or more angles right.

Such are squares, rectangles, and rectangled triangles, among plain figures; cubes, parallelepipeds, &c. among solids.

Solids are also said to be rectangular with respect to their situation: thus, if a cone, cylinder, &c. be perpendicular to the plane of the horizon, it is called a rectangular or right cone, cylinder, &c.

The ancients used the phrase *rectangular section of a cone*, to denote a parabola; that conic section, before Apollonius, being only considered in a cone, whose section by the axis would be a triangle, right-angled at the vertex. See *Conic Sections*.

Hence it was that Archimedes entitled his book of the quadrature of the parabola, by the name of "*Rectanguli Coni Sectio*."

RECTANGULAR Barometer. See **BAROMETER**.

RECTANGULAR Windmills. See **WINDMILLS**.

RECTIFICATION, compounded of *rectus*, right, *directus*, and *fio*, I became, the act of *rectifying*, i. e. of correcting, remedying, or redressing, some defect or error, in respect either of nature, art, or morality.

RECTIFICATION, in *Chemistry*, is the repeating of a distillation or sublimation several times, and generally with a less degree of heat than at first, in order to render the substance purer, finer, and freer from aqueous and earthy parts.

Rectification is a reiterated depuration of a distilled matter, *e. gr.* brandy, spirits, or oils, by distilling them over again, to render them more subtle, and exalt their virtues.

That the rectification of spirits may, in all cases, proceed with the greatest exactness, a due regard to it must be had even from the first fermenting the substance from which they are to be made, and continued through all the stages of distillation, the low wines, proof spirit, and alcohol. The management of the fermented liquor, to this purpose, is principally the letting it stand to subside after the fermentation is over, and the drawing it off clear and thin, not too rich for the still. The still is not to be overfilled with this. Great care must be taken to prevent its burning, and the fumes that run last must be kept separate, not mixed with the rest of the liquor distilled, which is now called the low wines. In the rectifying of these into proof spirit, great caution must be used that the fire be kept regular, not raised by sudden spirits, which always throw up the oil in large quantities, which is to be left behind. In the succeeding rectification of the proof spirit into alcohol, the same cautious management of the fire is necessary; and, in both this and the last, the fumes are not to be suffered to run in among the spirit, but to be saved separate. They may be all mixed together at last, and reduced to a spirit fit for burning in lamps; but the keeping out of the rectified liquor will keep away the coarsest and most stinking part of the oil of the ingredients.

By these easy means, without any additional trouble or charge, we might be furnished with a spirit greatly exceeding what we commonly meet with. And in general, the art and mystery of our sellers of the several sorts of English brandies, seem to consist in this prudent management, and in the adding a little of the *oleum vini*, or oil of wine-lees, to the spirits thus procured pure: this gives the flavour of foreign brandies, and is so extensive in its use, that half an ounce of it is sufficient for a hoghead of pure spirit.

Malt spirit is that which principally requires all this care in the rectification, because its oil is more nauseous and

offensive than that of any other spirit; but all others will be greatly the better for being treated in the same manner, and it is indeed necessary that they should for some particular uses.

It is remarkable, that no one method of combinatory rectification, that is, of the rectification performed by means of salt, and other additions, is suited to all the several kinds of spirits; scarcely indeed will any one way serve for any two spirits: but this method, by simple and careful distillation, is equally suited to all. Molasses-spirit, cyder-spirit, wine-spirit, or brandy, rum, and arrack, are all improved by it; and all of them are then known to be perfectly rectified, when, in the state of alcohol, they not only prove totally inflammable in a little vessel floating upon cold waters, but when poured into the purest spring water they have not the least power of making any change in it, nor leave any marks of oiliness, or that unctuousity which, on the mixture of the less pure spirits, floats on the top, and in certain lights gives the rainbow colours. Shaw's Essay on Distillery. See **ALCOHOL** and **DISTILLATION**.

Fixed salts are rectified by calcination, dissolution, or filtration.

Metals are rectified, *i. e.* refined, by the coppel; and reguluses by repeated fusions, &c.

In a word, all rectifications are founded upon the same principle; and consist in separating substances more volatile from substances less volatile; and the general method of effecting this is to apply only the degree of heat which is necessary to cause this separation.

RECTIFICATION of vitriolic Acid. See **CONCENTRATION**.

RECTIFICATION, in *Geometry*, is the finding of a right line equal to a proposed curve, or simply finding the length of a curve line; a problem which, even in the present advanced state of analysis, is attended in many cases with considerable difficulty; and was, in all, totally beyond the reach of the ancient geometers, who were not able to assign the length of any curve line whatever; though they could, in a few instances, determine the area of a curvilinear space. See **QUADRATURE**.

The first rectification of a curve line was effected by Mr. H. Neal, as we are informed by Dr. Wallis, at the conclusion of his Treatise on the Cissoid. This curve was the semicubical parabola, and Neal's rectification of it was published in July or August, 1657; and two years after, *viz.* in 1659, the same was done by Van Haureat in Holland. See Schooten's Commentary on Descartes' Geometry.

It is, however, to the doctrine of fluxions that we owe the complete rectification of curve lines, in finite terms, when they admit of it; and in others by means of infinite series, circular arcs, logarithms, &c.; of which method we shall give a general view in the present article.

Let **AMO** (*Plate XIII. Analysis, fig. 10.*) be a curve of any kind, whose ordinates are parallel to one another, and perpendicular to the axis **AH**; and let the fluxion of the absciss **AP** be denoted by Pp or MR , and Rm be taken to represent the corresponding fluxion of the ordinate **PM**, then will the tangent Mm be the line which the generating point of the curve would describe, if its motion were to become uniform at **M**; consequently this line will truly express the fluxion of the space **AM**. Hence putting $AP = x$, $PM = y$, and $AM = z$, we have $z = Mm = \sqrt{(MR^2 + Rm^2)} = \sqrt{(x'^2 + y'^2)}$; from which, and the equation of the curve, the value of z may be determined. But if all the ordinates of the proposed curve **ARM** (*fig. 11.*) be referred to a centre **C**; then, putting the tangent **RP**, intercepted by the perpendicular **CP**, = t , the arc **BN**, of a circle described about the centre **C**, = x , the radius

radius CN (or CB) = a , &c. (see QUADRATURE of Curves, Case 2.) we shall have $\dot{z} : \dot{y} :: y : t$ (CR) : t (RP);

and consequently, $\dot{z} = \frac{y \dot{y}}{t}$; whence the value of z will be found, if the relation of y and t is given.

I. To find the length of the semi-cubical parabola, of which the equation is $ax^2 = y^3$, or $x = \frac{y^{\frac{3}{2}}}{a^{\frac{1}{2}}}$.

Here $\dot{x} = \frac{3y^{\frac{1}{2}} \dot{y}}{2a^{\frac{1}{2}}}$, or $\dot{x}^2 = \frac{9y \dot{y}^2}{4a}$; substituting, therefore,

this value of $\dot{x}^2$ in the general expression

$\dot{z} = \sqrt{(\dot{x}^2 + \dot{y}^2)}$, we have

$$\dot{z} = \sqrt{\left(\frac{9y \dot{y}^2}{4a} + \dot{y}^2\right)} = \frac{\dot{y}}{2a^{\frac{1}{2}}} \sqrt{(9y + 4a)};$$

the fluent of which is

$$z = \frac{1}{27a^{\frac{1}{2}}} \times (9y + 4a)^{\frac{3}{2}} + C, \text{ correction.}$$

Now when the arc = 0, then $y = 0$; therefore

$$\frac{4a^{\frac{3}{2}}}{27a^{\frac{1}{2}}} + C = 0, \text{ or } C = -\frac{4a^{\frac{3}{2}}}{27a^{\frac{1}{2}}};$$

whence the complete fluent is

$$z = \frac{(9y + 4a)^{\frac{3}{2}} - 4a^{\frac{3}{2}}}{27a^{\frac{1}{2}}},$$

which is the length of the curve, answering to any length of the ordinate y .

II. To rectify the common parabola; or to find the length of any parabolic arc AM (fig. 11.) Let the parameter = a , the absciss = AP = x , &c. as above. From the well known property of this curve, $ax = y^2$; and $a\dot{x} = 2y\dot{y}$; consequently $\dot{x} = \frac{2y\dot{y}}{a}$, and $\dot{x}^2 = \frac{4y^2\dot{y}^2}{a^2}$, which substituted for $\dot{x}^2$ in the general expression for the length of the

curve, makes $\dot{z} = \left(\frac{4y^2\dot{y}^2}{a^2} + \dot{y}^2\right)^{\frac{1}{2}} = \frac{\dot{y}}{a} \times (a^2 + 4y^2)^{\frac{1}{2}}$;

which, thrown into an infinite series, becomes $= \frac{\dot{y}}{a} \times \left(a + \frac{2y^2}{a} - \frac{2y^4}{a^3} + \frac{4y^6}{a^5}, \&c.\right)$ i. e. $\dot{z} = \dot{y} + \frac{2y^2\dot{y}}{a^2} - \frac{2y^4\dot{y}}{a^4} + \frac{4y^6\dot{y}}{a^6}, \&c.$

The fluent of this series is $z = y + \frac{2y^3}{3a^2} - \frac{2y^5}{5a^4} + \frac{4y^7}{7a^6} - \dots$, &c. = the length of the curve AM required.

Otherwise: the above $\dot{z} = \frac{\dot{y}}{a} \times (a^2 + 4y^2)^{\frac{1}{2}}$ is $= \frac{\dot{y}}{a} \times \frac{a^2 + 4y^2}{(a^2 + 4y^2)^{\frac{1}{2}}} = \frac{a^2 y \dot{y} + 4y^3 \dot{y}}{a \times (a^2 y^2 + 4y^4)^{\frac{1}{2}}} = \frac{\frac{1}{2} a^2 y \dot{y} + 4y^3 \dot{y}}{a \times (a^2 y^2 + 4y^4)^{\frac{1}{2}}} = \frac{1}{a} \times (a^2 y^2 + 4y^4)^{-\frac{1}{2}} \times \left(\frac{1}{2} a^2 y \dot{y} + 4y^3 \dot{y}\right) + \frac{1}{4} a \times \frac{\dot{y}}{(\frac{1}{4} a^2 + y^2)^{\frac{3}{2}}}$. But the fluent of the first of these two terms is $= \frac{1}{2a} \times (a^2 y^2 + 4y^4)^{\frac{1}{2}} = \frac{y}{a} \times (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}}$;

and the fluent of the last of the two terms is $= \frac{1}{4} a \times \text{hyp.}$

log. of $y + (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}}$; therefore $z = \frac{y}{a} \times (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}}$

+ $\frac{1}{4} a \times \text{hyp. log. of } y + (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}}$. But when z and y vanish, or become equal 0, as they do at the vertex, this fluent becomes $= \frac{1}{4} a \times \text{hyp. log. of } \frac{1}{2} a$; and, therefore, the said fluent being corrected, gives the true value of z , or

the length of the curve AM $= \frac{y}{a} \times (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}} + \frac{1}{4} a$

$\times \text{hyp. log. of } y + (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}} - \frac{1}{4} a \times \text{hyp. log. of } \frac{1}{2} a$

$= \frac{y}{a} \times (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}} + \frac{1}{4} a \times \text{hyp. log. of } \frac{y + (\frac{1}{4} a^2 + y^2)^{\frac{1}{2}}}{\frac{1}{2} a}$.

Hence, if AC and DC (fig. 12.) be the conjugate semi-axes of an equilateral hyperbola; and AC = a , MP = $2y$, QM = x , then will AP = $x - a$; and $x^2 - a^2 = 4y^2$; therefore $x^2 = 4y^2 + a^2$; consequently $x = \sqrt{(4y^2 + a^2)}$. If then qm be supposed infinitely near QM, we shall have Qq = $\dot{y}$, and therefore the element of the area CQMA = $\dot{y} \times \sqrt{(a^2 + 4y^2)}$. Whence it appears, that the rectification of the parabola depends on the quadrature of the hyperbolic space CQMA.

III. To determine the length of an arc of the common hyperbola. Let the semitransverse axis be represented by b ,

and the femiconjugate by c , and we shall have $\frac{b^2 y^2}{c^2} = 2bx$

+ x^2 , from the nature of the curve (see HYPERBOLA);

and therefore $x = \frac{b \sqrt{(c^2 + y^2)}}{c}$ - b : hence $\dot{x} =$

$\frac{b y \dot{y}}{c \sqrt{(c^2 + y^2)}}$, and $\dot{z} = \sqrt{(\dot{y}^2 + \dot{x}^2)} = \sqrt{\left\{ \dot{y}^2 + \frac{b^2 y^2 \dot{y}^2}{c^2 \times (c^2 + y^2)} \right\}} = \dot{y} \sqrt{\left(1 + \frac{b^2 y^2}{c^4 + c^2 y^2}\right)}$; which, by con-

verting $\frac{b^2 y^2}{c^4 + c^2 y^2}$ into an infinite series, becomes $\dot{y} \sqrt{(1 +$

$\frac{b^2 y^2}{c^4} - \frac{b^2 y^4}{c^6} + \frac{b^4 y^6}{c^8} - \frac{b^2 y^8}{c^{10}}, \&c.)$ But still we have the

square root to extract: in order to which, let it be assumed

$= 1 + Ay^2 + By^4 + Cy^6 + Dy^8, \&c.$ Then, by squaring, and transposing, there arises

$1 + 2Ay^2 + 2By^4 + 2Cy^6 + 2Dy^8, \&c. + A^2 y^4 + 2AB y^6 + 2AC y^8 + B^2 y^8, \&c. = 0.$

$-1 - \frac{b^2}{c^4} \times y^2 + \frac{b^2}{c^6} \times y^4 - \frac{b^2}{c^8} \times y^6 + \frac{b^2}{c^{10}} \times y^8, \&c.$

Hence $A = \frac{b^2}{2c^4}$; $B = -\frac{b^2}{2c^6} - \frac{1}{2} A^2 = -\frac{b^2}{2c^6} - \frac{b^4}{8c^8}$; $C =$

$= \frac{b^2}{2c^8} - AB = \frac{b^2}{2c^8} + \frac{b^4}{4c^{10}} + \frac{b^6}{16c^{12}}, \&c. \&c.$ Therefore $\dot{z}$

$= \dot{y} \sqrt{(1 + \frac{b^2 y^2}{c^4}, \&c.)} = \dot{y} \times (1 + Ay^2 + By^4, \&c.)$

$= \dot{y} + \frac{b^2}{2c^4} \times y^2 \dot{y} - \left(\frac{b^2}{2c^6} + \frac{b^4}{8c^8}\right) \times y^4 \dot{y} + \left(\frac{b^2}{2c^8} +$

$\frac{b^4}{4c^{10}} + \frac{b^6}{16c^{12}} + \dots\right) \times y^6 \dot{y} + \dots$

$\frac{b^2}{2c^4} \times y^2 \dot{y} - \left(\frac{b^2}{2c^6} + \frac{b^4}{8c^8}\right) \times y^4 \dot{y} + \left(\frac{b^2}{2c^8} +$

$\frac{b^4}{4c^{10}} + \frac{b^6}{16c^{12}} + \dots\right) \times y^6 \dot{y} + \dots$

RECTIFICATION.

$$\frac{b^4}{4c^{10}} + \frac{b^6}{16c^{15}} \times y^5 j, \&c. \text{ And consequently } z = y + \frac{x}{2 \cdot 3} + \frac{3x^2}{2 \cdot 4 \cdot 5} + \frac{3 \cdot 5x^3}{2 \cdot 4 \cdot 6 \cdot 7} + \&c.) \times \sqrt{x}$$

$$\frac{b^2 y^3}{6c^4} - \left(\frac{b^2}{c^2} + \frac{b^4}{4c^4} \right) \times \frac{y^5}{10c^4} + \left(\frac{b^2}{c^2} + \frac{b^4}{2c^4} + \frac{b^6}{8c^6} \right) \times \frac{y^7}{14c^6}, \&c.$$

$$z = (1 + \frac{y^2}{2 \cdot 3} + \frac{3y^4}{2 \cdot 4 \cdot 5} + \frac{3 \cdot 5y^6}{2 \cdot 4 \cdot 6 \cdot 7} + \&c.) \times y$$

$$z = (1 - \frac{t^2}{3} + \frac{t^4}{5} - \frac{t^6}{7} + \frac{t^8}{9} + \&c.) \times t$$

$$z = \left(\frac{s-r}{s} + \frac{s^3-r^3}{2 \cdot 3s^3} + \frac{3(s^5-r^5)}{2 \cdot 4 \cdot 5s^5} + \&c. \right) \times r$$

By the very same way of proceeding, the arc of an ellipsis may be found, the equations of the two curves differing in nothing but their signs.

IV. To rectify the spiral of Archimedes. The value of t (A T, fig. 13.) being denoted by $\frac{by}{\sqrt{(b^2+y^2)}}$ (see TANGENT of the Spiral, &c.) we have $\dot{z} \left(= \frac{y \dot{y}}{t} \right) = j \frac{\sqrt{(b^2+y^2)}}{b}$; which fluxion being the same as that expressing the arc of the common parabola (Prob. II.), by inserting in the expression $\dot{z} = \frac{j}{a} \times (a^2 + 4y^2)^{\frac{1}{2}}$, b for $\frac{1}{2} a$, its fluent will, therefore, be truly represented by the measure of the said arc, or by $\frac{\frac{1}{2} y \sqrt{(b^2+y^2)}}{b} + \frac{1}{2} b \times \text{hyp. log. } \frac{y + \sqrt{(b^2+y^2)}}{b}$, the value there found, by making the proposed substitution.

V. To rectify the involute of a circle, whose nature is such, that the part PR (fig. 14.) of the tangent intercepted by the point of contact and the perpendicular CP, is every where equal to the radius CO of the generating circle.

In this case $\dot{z} \left(= \frac{y \dot{y}}{t} \right) = \frac{y \dot{y}}{a}$, we obtain $z = \frac{y^2}{2a}$, which, corrected by making $y = a = AC$, becomes $\frac{y^2 - a^2}{2a} \left(\frac{CP}{2CA} \right)$, the true measure of the required arc AR.

VI. To find the length of a circular arc.—This may be expressed either in terms of the sine, cosine, versed sine, or any other trigonometrical line, as follows. First,

Let the versed sine = x , the sine = y , radius = r , and arc = z , then, by the property of the circle, $y^2 = 2rx - x^2$

or, putting tangent = t $\quad \quad \quad y^2 = \frac{r^2 t^2}{r^2 + t^2}$

and secant = s , gives $\quad \quad \quad y^2 = \frac{s^2 - r^2}{s^2} r^2$

as are readily deduced from the known properties of the circle.

Now, by means of these values of y^2 , or of $2rx - x^2$, and the general equation $\dot{z} = \sqrt{(\dot{x}^2 + \dot{y}^2)}$, we readily draw the following values of $\dot{z}$, viz.

$$\dot{z} = \begin{cases} \frac{r \dot{x}}{\sqrt{(2rx - x^2)}} = \frac{r \dot{y}}{\sqrt{(r^2 - y^2)}} = \\ \frac{r^2 \dot{t}}{r^2 + t^2} = \frac{r^2 \dot{s}}{s^2 - r^2} \end{cases}$$

the fluents of which can only be found in series, which are as follows; making radius $r = 1$, viz.

where r is retained in the latter for sake of analogy.

It is obvious, therefore, that the arc may be computed by any of these, in terms either of the sine or versed sine, tangent or secant, and consequently also in terms of the cosine, co-tangent, co-secant, &c.

Thus, in the first, taking $x = \frac{1}{2}$, which is the versed sine of 60° , we have

$$\text{arc } 60^\circ = \left(1 + \frac{1}{2 \cdot 3} + \frac{3}{2^3 \cdot 3 \cdot 4 \cdot 5} + \frac{3 \cdot 5}{2^5 \cdot 4 \cdot 6 \cdot 7} \right) \sqrt{\frac{1}{2}}$$

In the second, assuming $y = \frac{1}{2} = \sin. 30^\circ$, we have

$$\text{arc } 30^\circ = \left(1 + \frac{1}{2^3 \cdot 3} + \frac{3}{2^5 \cdot 4 \cdot 5} + \frac{3 \cdot 5}{2^7 \cdot 4 \cdot 6 \cdot 7} \right) \times \frac{1}{2}$$

In the third, assuming $t = 1 = \tan. 45^\circ$, we obtain

$$\text{arc } 45^\circ = \left(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \&c. \right) \cdot r$$

In the fourth, assuming $s = 2 = \sec. 60^\circ$, we get

$$\text{arc } 60^\circ = \left(\frac{2-1}{2} + \frac{2^3-1^3}{2^4 \cdot 3} + \frac{3(2^5-1^5)}{2^6 \cdot 4 \cdot 5} + \&c. \right) \cdot r$$

Then multiplying the numbers obtained from these series by the number of times that the arc is contained in the whole circumference, will give the circumference required.

But no one of these series is sufficiently convergent for ascertaining the circumference of the circle to a great degree of accuracy, and therefore other methods have been contrived, in order to produce series better calculated for this purpose, of which that of Machin has been the most popular; though it does not appear that he employed it in his celebrated quadrature or rectification, in which he found the circumference to one hundred places of figures.

In order to render these series more converging, it is obvious that less arcs must be assumed, and the difficulty consists only in finding the tangents (for example, using that series) of a small arc, which may be expressed in numbers that are tolerably manageable in the general series.

For this purpose Machin, knowing the tangent of 45° to be 1, and that the tangent of an arc being known, any multiple of it is readily found, considered, that if there were assumed some small simple number for the tangent of an arc, and then the tangent of the double arc were continually taken, until a tangent be found nearly equal to 1, the tangent of 45° : by taking the tangent of this small difference between 45° and the multiple arc, there would be had two very small tangents, the one of the first arc, and the other of this difference. Then computing the arc to these tangents, whether the measure of them in degrees, &c. were known or not, the whole arc of 45° would become known; viz. by multiplying the first by the assumed multiple, and adding the last arc to the product, if the tangent of the multiple arc were less than 1, or the arc itself less than 45° ; but subtracting it if greater.

Having

RECTIFICATION.

Having thus laid down his plan of operation, by a few trials he fell upon a number well suited to his purpose, *viz.*

knowing the tangent of $\frac{1}{4}$ of 45° , or $11^\circ 15'$, to be very nearly $\frac{1}{5}$, radius being 1, he assumed for his first arc that

whose tangent is $\frac{1}{5}$; then since $\tan. 2a = \frac{2 \tan. a}{1 - \tan.^2 a}$,

he had $\frac{5}{12}$ for the tangent of his double arc, and $\frac{120}{119}$ for

the double of this, or of four times the first, which being a little greater than 45° , was well adapted to his views; for by a known trigonometrical property, $\tan. (a - 45) = \frac{\tan. a - 1}{\tan. a + 1}$; that is, the tangent of the small arc, which is

equal to the excess of his multiple above 45° , was $\frac{\frac{120}{119} - 1}{\frac{120}{119} + 1}$

$= \frac{1}{239}$. He had, therefore, two arcs to compute, the one

having for its tangent $\frac{1}{5}$, and the other $\frac{1}{239}$; and then four

times the first of these arcs minus the latter, would evidently give the exact arc of 45° , and both these numbers being such as to converge very well in the general series, the difficulty attending the usual approximation was avoided. Other approximations, however, have since been discovered, which, if not more rapid, their investigation is, at least, more simple, of which, perhaps, that of Euler's is the most deserving of notice. This celebrated geometer observes, that every arc whose tangent is commensurable with the radius, as, for instance, 45° , may be divided into two arcs, of which the tangents, though much smaller, are still commensurable with the radius; for since

$$\tan. (a + b) = \frac{\tan. a + \tan. b}{1 - \tan. a \tan. b},$$

we have also

$$\tan. a = \frac{\tan. (a + b) - \tan. b}{\tan. (a + b) \cdot \tan. b + 1};$$

where it is obvious that if $\tan. (a + b)$ and b be rational, $\tan. a$ will also be rational; thus, if $\tan. (a + b) = \tan. 45^\circ$

$= 1$, and $\tan. b = \frac{1}{2}$, we have $\tan. a = \frac{1}{3}$, and we shall

evidently have a similar result, whatever rational fraction we assume for $\tan. b$.

We shall find, therefore, by the series which gives the arc in terms of the tangent, each of these arcs, the sum of which will evidently be the measure of the whole arc sought; whether the arcs themselves, which belong to these tangents, be rational or irrational, with respect to the whole arc of which they form the parts. These tangents, substituted in

the general series above, give arc to $\tan. \left(\frac{1}{2}\right) =$

$$\frac{1}{2} - \frac{1}{3 \cdot 2^3} + \frac{1}{5 \cdot 2^5} - \frac{1}{7 \cdot 2^7} + \frac{1}{9 \cdot 2^9} - \&c.$$

and arc to $\tan. \left(\frac{1}{3}\right) =$

$$\frac{1}{3} - \frac{1}{3 \cdot 3^3} + \frac{1}{5 \cdot 3^5} - \frac{1}{7 \cdot 3^7} + \frac{1}{9 \cdot 3^9} - \&c.$$

In both which series, the terms diminish much more rapidly than in the original series, and may therefore be computed with tolerable ease.

But it is evident that we may proceed farther in this approximation, by dividing each of these into other two arcs, by which means the convergency will obviously be much more rapid; and though, generally speaking, for every subdivision we double the number of our series, yet the degree of convergency is so much the greater as amply to compensate for the additional number of series. Besides, we may always subdivide our greater arc, so that one of its subdivisions shall be the same as the smaller arc, in which case we do not

increase the number of series. Thus; arc to $\tan. \frac{1}{2} =$ arc

to $\tan. \frac{1}{3} +$ arc to $\tan. \frac{1}{7}$; therefore arc to $\tan. 1 = 2$

arc to $\tan. \frac{1}{3} +$ arc to $\tan. \frac{1}{7}$. Again; arc to $\tan. \frac{1}{3}$

$=$ arc to $\tan. \frac{1}{7} +$ arc to $\tan. \frac{2}{11}$; therefore arc to $\tan.$

$1 = 3$ arc to $\tan. \frac{1}{7} + 2$ arc to $\tan. \frac{2}{11}$, and so on to

any extent required, which might in course be pursued so far as to render the operation as simple and as little laborious as can be expected in such kind of computations. Even with these already mentioned, the circumference of the circle might undoubtedly be computed to 200 places of decimals, with less labour than it cost Vieta to carry them to 10 places, or Romanus to 15.

The reader will observe, that this approximation differs from Machin's in nothing except the simplicity and generality of the investigation; for if we make the successive subdivision of the greater arc, so as always to include in it the smaller one, we shall find in our results the identical formula of Machin.

Let us repeat our former expression

$$\tan. a = \frac{\tan. (a + b) - \tan. b}{1 - \tan. a \cdot \tan. b}.$$

Let $\tan. (a + b) = \frac{R}{T}$, $\tan. a = \frac{R'}{T'}$, $\tan. b = \frac{r}{t}$, and

we shall have generally $\frac{R'}{T'} = \frac{Rt - Tr}{Rr + Tt}$.

Let now $\tan. (a + b) = 1$, answering to arc 45° , so that $R = 1$, and $T = 1$; assume also $r = 1$, then, by constantly substituting, in the general expression, the values found for R' , R'' , R''' , &c. and T' , T'' , T''' , &c. for R and T respectively, we shall have

$$\frac{R'}{T'} = \frac{t - 1}{t + 1}$$

$$\frac{R''}{T''} = \frac{t^2 - 2t - 1}{t^2 + 2t - 1}$$

$$\frac{R'''}{T'''} = \frac{t^3 - 3t^2 - 3t + 1}{t^3 + 3t^2 - 3t - 1}$$

$$\frac{R^{iv}}{T^{iv}} = \frac{t^4 - 4t^3 - 6t^2 + 4t + 1}{t^4 + 4t^3 - 6t^2 - 4t + 1}$$

$$\frac{R^v}{T^v} = \frac{t^5 - 5t^4 - 10t^3 + 10t^2 + 5t - 1}{t^5 + 5t^4 - 10t^3 - 10t^2 + 5t + 1}$$

$$\frac{R^{(n)}}{T^{(n)}} = \frac{t^n - n t^{n-1} - \frac{n(n-1)}{1 \cdot 2} t^{n-2} + \&c.}{t^n + n t^{n-1} - \frac{n(n-1)}{1 \cdot 2} t^{n-2} - \&c.}$$

So that, generally, arc to tan. 1 = $n \times$ arc to tan. $\frac{1}{t} +$ arc

to tan. $\frac{R^{(n)}}{T^{(n)}}$. If we take $n = 1$, and $t = 3$, we have arc

tan. 1 = arc tan. $\frac{1}{3} +$ arc tan. $\frac{1}{2}$. If $n = 2$, and $t = 3$,

we have arc tan. 1 = $2 \times$ arc tan. $\frac{1}{3} +$ arc tan. $\frac{1}{7}$. If

$n = 4$, and $t = 5$, we have arc. tan. 1 = $4 \times$ arc tan. $\frac{1}{5} -$

arc tan. $\frac{1}{239}$; which is the formula of Machin; and by

giving other values to n and t , a variety of other formulæ might be found, though it would, probably, be difficult to find one more convergent than the last. The reader will find more on this subject in vol. i. of Dr. Hutton's Traacts.

We shall conclude this article by giving the circumference of the circle to 155 places, as given by Zach, from a manuscript which he saw in the Ratcliff library at Oxford, distinguishing the periods of the several approximations of different authors mentioned in the preceding part of this article, and the article QUADRATURE.

The diameter of a circle being 1, the circumference will be

a	b	c	d
3.14 159,	2 6535,	89793,	2 3846,
		e	
26433,	83279,	50288,	41971,
69399,	37510,	58209,	74944,
		f	
59230,	78164,	06286,	20899,
		g	
86280,	34825,	34211,	70679,
		*	
82148,	08651,	32823,	06647,
	h		
09384,	46 095,	50582,	23172,
		i	
53594,	08128,	4802.	

a, Archimedes; b, Métiüs; c, Vieta; d, Adrianus Romanus; e, Van Ceulen; f, Abraham Sharp; g, Machin; h, Lagny; i, Oxford Manuscript.

* This figure is a 7 in Lagny's approximation, but Vega, in the revision of the computation, asserts that it ought to be an 8, as we have given it.

RECTIFIED SPIRITS, &c. are such as have undergone the operation of rectification, or have been distilled over and over, to separate from them any heterogeneous matter, which might have arisen with them in the former distillations.

Hence we say, spirit of wine twice rectified, thrice rectified, &c.

It is the rectification that makes the difference between brandy and rectified spirits of wine. See SPIRITS.

RECTIFIER, in *Navigation*, is an instrument used for determining the variation of the compass, in order to rectify the ship's course, &c.

It consists of two circles, either laid upon, or let into one another, and so fastened together in their centres, that they represent two compasses, the one fixed, the other moveable: each is divided into thirty-two points of the compass, and three hundred and sixty degrees, and numbered both ways, from the north and the south, ending at the east and west in ninety degrees.

The fixed compass represents the horizon, in which the north, and all the other points, are liable to variation.

In the centre of the moveable compass is fastened a silk thread, long enough to reach the outside of the fixed compass; but if the instrument be made of wood, an index is used instead of the thread.

RECTIFIER, in the *Distillery*, the person whose employment is to take the coarse malt-spirit of the malt-stiller, and re-distil it to a finer and better liquor. The art of the rectifier might be entirely set aside, if the malt-stiller could make his spirit perfect at a second operation; which seems very practicable, if the malt-stillers could be induced to forsake their old practice. The great things to be recommended for the improvement of their art, would be, first, the brewing in perfection; and secondly, the keeping of their wash after the manner of stale beer, till it has entirely lost its malt flavour, and acquired a pungent acid vinosity; and then, thirdly, leaving out the lees, to distil with a well-regulated fire. It is scarcely to be thought how pure a spirit is to be obtained from malt this way; but the great art would be, the finding of a method to make malt liquors artificially stale, bright, and flavourless, though otherwise vinous. Shaw's Lectures, p. 223.

RECTIFYING of Curves. See RECTIFICATION.

RECTIFYING of the Globe or Sphere, is a previous adjusting of the globe or sphere, to prepare it for the solution of problems. For the method of doing it, see *Use of the Celestial GLOBE*.

RECTILINEAR, RIGHT-LINED, in *Geometry*, is applied to figures whose perimeter consists of right lines.

RECTILINEAR Angle, Maps, and Superficies. See the substantives.

RECTITUDE, RECTITUDO, *Rectum*, in matters of philosophy, refers either to the act of judging, or of willing; and therefore, whatever comes under the denomination of rectitude is either what is true, or what is good: these being the objects about which the mind exercises its two faculties of judging and willing.

Rectitude of the mind, considered as it judges, i. e. rectitude of the faculty of judgment, consists in its agreement and conformity to the nature and reason of things, and in its determining and deciding about them according to what their constitutions, properties, uses, &c. really are.

Rectitude of the mind, considered as it wills, called also *moral rectitude*, or *uprightness*, consists in the choosing and pursuing of those things which the mind, upon due enquiry and attention, clearly perceives to be good; and avoiding those that are evil.

RECTITUDINES, in *Law*, rights, or legal dues, belonging either to God, or man. See RIGHT.

RECTO, a writ usually called a *writ of right*; of so high a nature, that whereas other writs in real action are only to recover the possession of the lands, &c. in question, lost by the plaintiff, or his ancestor; this aims to recover both the seisin thus lost, and the property of the thing: so that both rights are here blended together; that of *property*, and that of *possession*.

If a man lose his cause upon this writ, he is without all remedy.

There are two kinds of this writ: *breve magnum de reço*, or

or *breve de recto patens*, a writ of right patent; and *recto clausum*, a writ of right close.

The first is so called, because sent open. It lies only for him that hath fee-simple in the lands sued for, against the tenant of the freehold at least.

Indeed, the writ of right patent is extended, in practice, beyond its original intention; for a writ of right of dower, which lies for the tenant in dower, is patent; and so in several other cases. Fitzherb.

The writ of right close, called also *breve parvum de recto*, is directed to the lord of ancient demesne, or the bailiff of the king's manors; and lies for those who hold lands and tenements by charter, in fee-simple, or in fee-tail, or for term of life, or in dower, if they be ejected out of such lands, or disseised. In such case a man, or his heirs, may sue out the writ of right close, directed to the lord of ancient demesne, commanding him to do him right in his court. This is called a writ *secundum consuetudinem manerii*. See POSSESSION, PROPERTY, TITLE, and WRIT.

RECTO de advocacione ecclesie, a writ of right, lying where a man has right of advowson in fee to him, and his heirs; and, the incumbent dying, a stranger presents his clerk to the church; and he, not having brought his action of *quare impedit*, nor *darrein presentment*, within six months, has suffered the stranger to usurp upon him. See *Disturbance of PATRONAGE*, *QUARE impedit*, and *ASSISA darrein presentment*.

RECTO de custodia terre & heredis, a writ which lies for him whose tenant dying in his nonage, a stranger enters, and takes the body of the heir.

This writ as to lands holden *in capite*, or by knight's service, is become useless by the stat. 12 Car. II. but not where there is a guardian in socage, or appointed by the last will of the ancestor. See GUARDIAN.

RECTO de dote, a writ of right of dower, which lies for a woman that has received part of her dower, and proceeds to demand the remnant in the same town against the heir, or his guardian. This extends either to part or the whole, and is a more general remedy than that mentioned in the next article.

RECTO de dote unde nihil habet, is a writ of right which lies in case where the husband, having divers lands and tenements, has assured no dower to his wife; and she is thereby driven to sue for her thirds against the heir, or his guardian. See DOWER, and *Writ of ENTRY*.

RECTO quando or *quia dominus remisit*, a writ of right, which lies in case where lands or tenements in the signory of any lord, are in demand by a writ of right.

If the lord hold no court, or, at the prayer of the demandant or tenant, send his writ to the king's court, to put the cause thither for that time; this writ illues for the other party, and has its name from the words comprised, which is the true occasion of it.

RECTO de rationabili parte, a writ that lies between privies of blood, as brothers in gavel-kind, or sisters, or other coparceners, as nephews and nieces, and for land in fee-simple.

If a man lease his land for life, and afterwards die, leaving issue two daughters, and, after, the tenant for life likewise dies; the one sister entering on all the land, and so deforcing the other, the sister so deforced shall have this writ to recover her part.

RECTO sur disclaimer, a writ which lies where the lord, in the court of common pleas, does avow upon his tenant, and the tenant disclaims to hold of him; upon which disclaimer the lord shall have this writ. This takes place when the tenant upon a writ of assize for rent, or on a re-

plevin, disowns or disclaims his tenure; whereby the lord loses his verdict; in which case the lord may have this writ, grounded on this denial of tenure, and shall, upon proof of the tenure, recover back the land itself so holden, as a punishment to the tenant for such his false disclaimer. This piece of retaliating justice, whereby the tenant who endeavours to defraud his lord is himself deprived of the estate, as it evidently proceeds upon feudal principles, so it is expressly to be met with in the feudal constitutions: "vassallus, qui abnegavit feudum ejusve conditionem, exspoliabitur."

RECTO folio. See FOLIO.

RECTOR of a parish, the parson, or he who has the charge or cure of a parish church. See PARSON.

If the predial tythes of the parish be impropriated, or appropriated, *i. e.* either in lay hands, or in those of some ecclesiastical community, then, instead of *rector*, the parson is called *vicar*, (which see). In England are reckoned 3485 rectories.

The name *rector* denotes him governor or ruler, *quia tantum jus in ecclesia parochiali habet, quantum prelatus in ecclesia collegiata*.

RECTOR also denotes the chief elective officer in several foreign universities, particularly in that of Paris.

RECTOR is also used in several convents for the superior, or officer who governs the house.

The Jesuits used it for the superiors in such of their houses as were either seminaries, or colleges.

RECTORY, or *RECTORATE*, *Rectoria*, a parish church, parsonage, or spiritual living, with all its rights, glebes, and tythes.

RECTRICES, in *Ornithology*, denote the strong feathers of the tails of birds.

RECTUM INTESTINUM, in *Anatomy*; or in English, simply the *rectum*; is the last portion of the large intestine, and of the whole alimentary canal. It begins at the left sacro-iliac symphysis, below the sigmoid flexure of the colon, and ends at the anus. See INTESTINE.

RECTUM, *Abcesses in the Neighbourhood of*. See FISTULA in Ano.

RECTUM, *Concretions and extraneous Substances lodged in*. The concretions formed in the larger intestines, and especially in the rectum, by the accumulation and protracted lodgment of the feces, may become the cause of obstinate constipation, which can only be removed by their extraction. Sometimes these masses of indurated matter include no extraneous substance; in other instances, their nucleus is a biliary calculus; in a vast number of cases, they are merely composed of the feces in a dry hardened state. It is remarked that women, and persons of advanced age, are most subject to the constipation arising from the obstruction thus occasioned in the large intestines. Children and adults in the vigour of life are not, however, entirely exempt from the disorder, though they seldom have it, except when the formation of such concretions in the bowels has been brought on by swallowing a large quantity of hard indigestible bodies, like cherry and plum-stones. Lastly, excessively hardened masses of fecal matter have been noticed in patients who have for a long while been confined to bed in the recumbent posture by severe diseases.

Whatever may be the cause of the disorder, whether the defect itself consists in a mere accumulation of indurated feces, with which the rectum is distended, and behind which the excrement is detained; or whether the constipation is not complete, the concretion allowing the liquid part of the feces to pass out between it and the inside of the intestine; the existence of the hardened mass may be known by

by the constipation which it produces; by the sense of weight which the patient feels about the fundament; and also by the possibility of actually touching the indurated obstructing body, when a finger is introduced up the rectum.

Oily emollient clysters, and carminative draughts, will serve for expelling such concretions as are not of too firm a consistence; but the extraction of them is absolutely necessary when they are particularly hard. The operation is to be done with a spoon, or suitable forceps, properly oiled; and, after the concretion has been removed, an emollient clyster is to be administered, in order to allay any irritation which may have been caused by the introduction of the requisite instruments. When the sphincter ani contracts so forcibly, that the operation is attended with extreme pain and difficulty, we are advised by surgical writers to make a dilatation of the anus, by practising an incision at its posterior angle. A wound made in this direction cannot do injury to any part of consequence, whilst there would be a risk of wounding the urethra in the male, or the vagina in the female subject, if the cut were made at the anterior angle. An incision, carried laterally, would be apt to injure the pudic vessels. A division of the fibres of the sphincter ani does not produce any material permanent weakness of its action, and a paralysis of this muscle, according to Richerand, can never proceed from such a cause. *Nosographie Chirurgicale*, tom. iii. p. 414. edit. 2.

The hard concretions which lodge in the rectum cannot be reached with the finger when they are situated high, and, in this circumstance, the surgeon must use a probe, or sound, in order to assure himself positively of their presence, their moveableness, and their size.

With regard to foreign bodies lodged in this intestine, some have been swallowed, and have passed through the whole extent of the alimentary canal; while others have been pushed up the anus to a greater or lesser height. The extraction of these last is generally attended with a great deal of difficulty, and even demands on the part of the operator more than ordinary sagacity, in consequence of the various shapes, the hardness, and the fragility of these different bodies. Glass phials, instrument cases, shuttles, &c. have been introduced into the rectum by maniacs. One person of this description put into his rectum a flint-stone, which did not admit either of being extracted, or broken, owing to its hardness, and slippery surface, and which in the end caused the patient to die in the greatest agony, with swelling and gangrenous mischief in the abdomen. Marchetti has recorded an instance, in which a pig's tail, hardened by cold, was forcibly thrust up the rectum of a girl of the town. This extraneous body could not be withdrawn, as the short bristles, which all inclined outward, immediately came into contact with and pierced the inner part of the bowel. It remained in the part six days, and occasioned a train of alarming symptoms, such as fever, vomiting, swelling of the abdomen, and obstinate constipation. Marchetti fastened a ligature to the end of the foreign body, which protruded at the anus, and then passed the ligature through a long piece of reed, which he introduced up the rectum, in order that the foreign body might be drawn through this tube without the intestine being lacerated. The experiment was completely successful. *Obf. Med. Chir.* p. 126.

In another example a piece of wood, three inches long, and two in width, was introduced into the rectum. Colic, tension of the abdomen, fever, constipation, and difficulty of making water, came on, and lasted six days. The impossibility of removing the extraneous substance with a

pair of forceps, led to the idea of using a borer, which, having been passed up the rectum under the guidance of the finger, was inserted deeply enough into the piece of wood to draw it out. The extraction, however, could not be effected without a great deal of pain. See *Mélanges de Chirurgie*, par M. Saucerotte, p. 484. *Mémoires de l'Académie de Chirurgie*, tom. v. p. 605. *Lafus, Pathologie Chirurgicale*, tom. ii. p. 569, edit. 2.

RECTUM, Congenital and Syphilitic Contractions of its inferior Portion. A contraction of the lower end of the rectum is sometimes an original malformation; but more frequently it arises from what has been considered by various surgical authors to be a venereal thickening of the parietes of this intestine. If this be really a syphilitic disorder, a circumstance which is to be doubted, it is certainly as grievous as any of the more common effects of the venereal disease. Excrescences grow from the mucous membrane at the rectum, and discharge a purulent matter, which is continually oozing from the anus. When a finger is passed within this aperture, the irregularities occasioned by the tumour may be plainly felt. Such writers as believe in the syphilitic nature of this complaint inform us, that the truth of this may be known by the antecedent and co-existent symptoms of the venereal disease. They admit, however, that the disorder almost always lasts after the cure of every other mark of syphilis, and they caution us not to persist rashly in administering mercury any longer for a disease which cannot be further benefited by it. These circumstances are quite sufficient to prove that there is not much reason for the doctrine, that this sort of contraction of the lower end of the rectum is venereal.

Such writers as consider the complaint to be connected with syphilis, of course recommend the exhibition of mercury, and they further advise the frequent injection into the rectum of a weak solution of the oxy muriate of the same mineral. Tents, smeared with mercurial ointment, are also recommended to be passed into the bowel. The latter applications are stated to have the advantage; 1st, of opposing, by mechanical pressure, the further increase of the excrescences; 2dly, of dilating the contracted part; and, 3dly, of acting on the disease by their medicinal quality.

For our own part, we much doubt the reality of the venereal nature of the foregoing complaint. The language of the advocates for such a doctrine must raise suspicions, that they are influenced in their judgment more by prejudice than reason. "The venereal affection of the coats of the rectum (says one of these writers) almost always lasts after the total extinction of the syphilitic virus. Then, we ought to be content with the employment of dilating mechanical means, without persisting in the use of medicines, which would serve only to ruin the patient's constitution. An elastic gum cannula is to be preferred, and it should be of a conical shape, in order that it may be gradually introduced further and further, in proportion as the dilatation of the bowel is effected." *Richerand, Nosographie Chirurg.* tom. iii. p. 418, edit. 2.

In cases of congenital contraction of the rectum, the only plan which can be adopted, is that of making an incision through the posterior part of the intestine.

RECTUM, Polypi of. Sometimes, though not often, polypi grow from the mucous membrane of the rectum, and by their size obstruct the passage of the feces. Their existence is at first manifested by an uneasy sense of heaviness, and afterwards they are protruded outwardly in the efforts which the patient makes at stool. The anus contracting after their expulsion, their roots become strangulated, so that they cannot return, and excessive agony is produced.

In this circumstance, the surgeon should take the opportunity of removing them with a knife, after having tied their root, or even without this precaution. The lining of the rectum, freed from the weight of the tumour, immediately retracts, and if the polypus should have received a supply of blood from a large vessel, hemorrhage may ensue. Such accident may be remedied by completely distending the wounded part of the rectum with a large piece of sponge, or with a compress of lint; but as it is easier to prevent the hemorrhage altogether, than to stop it after it has occurred, we would advise surgeons, whenever the excrescence is of any size, always to tie its root before removing the rest of it with a cutting instrument.

RECTUM, *Prolapsus of*. See PROLAPSUS Ani.

RECTUM, *Scirrhus-contracted*. Scirrhus of the rectum is not uncommon at an advanced period of life. Sometimes it extends over a considerable length of the gut, but generally it is more circumscribed. The coats of the bowel become much thicker and harder than in the natural state. The muscular coat is subdivided by membranous septa, and the internal coat is sometimes formed into hard irregular folds. The surface of the inner membrane is occasionally ulcerated, so as to form a cancerous disease. Every vestige of the natural structure is occasionally lost, and the gut is changed into a gristly substance. The cavity of the bowel is always rendered narrow at the scirrhus part, and is sometimes almost obliterated. When the passage through the gut is much obstructed, the bowel is always a good deal enlarged just above the stoppage, or stricture, from the accumulation of the feces there. As the disease advances, adhesions form between the rectum and adjacent parts, and ulcerations produce communications between them.

The disease is usually not much noticed till somewhat advanced, not being at first very painful. The patient only thinks that he is constive, and that he voids his stools with a little difficulty. In time, a good deal of pain is felt in the part affected, especially at stool, after which some relief is experienced. Pus and blood may sometimes be noticed with the excrement, particularly when the disease has advanced to the ulcerated state. The patient at length becomes fallow, the constitution suffers, and dissolution follows. Severe tenesmus attends the whole course of the disease.

Default has often seen the disease form a communication between the rectum and vagina, and the feces have passed through the latter part. In the latter stage of the affliction, the rectum, bladder, vagina, uterus, and adjacent parts, are all involved in one common ulceration.

When the disease has attained the ulcerated state, it is probably always incurable. Palliatives can now only be resorted to, such as anodyne and emollient glysters, the warm-bath, &c. with the exhibition of medicines like opium, cicuta, uva ursi, &c. Claudius applied his remedies to the inside of the bowel by means of tents, and did not employ the latter as a mode of curing the disease, when less advanced. Valsalva used to introduce a cannula pierced with numerous holes, when his patient got into the bath, so as to let the fluid enter the intestine. Numerous practitioners, among them Morgagni, made mercurials the base of their treatment, from a supposition that the complaint was of venereal origin.

When the disease is not attended with ulceration, the contraction and thickening of the gut may be diminished by introducing bougies, keeping them for a certain time, every day, so introduced, and increasing their size gradually. The pressure of these instruments seems to lessen the disease, and stop its progress; a proof that its nature differs from

that of what is usually understood by scirrhus. Default used to employ long tents, made of lint, smeared with cerate, and passed into the bowel by means of a probe, with a forked end. This surgeon gradually increased the size of the tents, so as to continue the compression, to which he conceived all the good was owing. Their length was also augmented by degrees. Fresh ones were, at first, introduced twice every day. When any hardnesses were situated on the outside of the anus, Default cured them on the same principle, viz. by making pressure on them with compresses and a bandage. This eminent surgeon effected a cure of a scirrhus-contracted rectum by this method. The woman was taught to pass occasionally the tents herself, so as to prevent a relapse. The disease is said to afflict women more frequently than men: from a comparative table kept at the Hôtel-Dieu, this has been the case there in the proportion of ten to one. See *Œuvres Chirurgicales de Default*, tom. ii. p. 422.

RECTUM, *Hemorrhoidal Swellings of*. See HEMORRHOIDS.

RECTUM, in *Law*. See RECTO.

RECTUM, in our old *Law Writers*, is also used for a trial or accusation.

RECTUM, *Commune*, denotes a trial at law, or in the common course of law. *Stare ad rectum*, denotes to stand a trial. *Rectum rogare*, to petition the judge to do right.

RECTUS, in *Anatomy*, a name applied to several muscles, generally, but not invariably, distinguished by the straightness of their fibres, or of their general direction.

RECTUS abdominis. See OBLIQUUS.

RECTUS abducens, or externus,	} muscles of the globe of the eye. See EYE.
RECTUS adducens, or internus,	
RECTUS attollens, or superior,	
RECTUS depressens, or inferior,	

RECTUS anterior cruris, or femoris,	} synonyms of the RECTUS cruris; which see.
RECTUS extensor cruris, or femoris,	

RECTUS capitis anticus major et minor. See RECTUS internus.

RECTUS capitis internus major, rectus anticus major, trachelo-fons-occipitien; a muscle of the head, flattened, broader and thicker above than below, occupying the anterior and lateral part of the neck, and reaching from the transverse process of the sixth cervical vertebra, to the inferior surface of the basilar process of the occiput. Its anterior surface is covered by the carotid artery, the internal jugular vein, the nerve of the eighth pair, the great sympathetic, and the pharynx. The longus colli, the rectus capitis internus minor, the articulations of the occiput and atlas, and of the latter bone, and the second vertebra, are covered by its posterior surface. The inner edge lies on the longus colli, and is connected to it by cellular substance: the outer is fixed to the front of the transverse processes of the sixth, fifth, fourth, and third cervical vertebrae, and is unattached above the latter. The lower end, very thin and pointed, is fixed to the transverse process of the sixth cervical vertebra: it ascends with a little obliquity from without inwards, increasing in breadth and thickness: it approaches the muscle of the opposite side, and is attached by its upper end to the basilar process of the occipital bone, in front of the foramen magnum. At the upper part of this muscle is a broad and thin aponeurosis, which descends on the anterior and inner surface: the attachments to the transverse processes are by small tendons terminating in muscular portions. The muscular fibres run obliquely between the last mentioned tendons and the aponeurosis.

This muscle bends the head forwards on the neck; and restores it after it has been carried backwards. The muscle

of one side, acting singly, inclines the head towards its own side.

RECTUS capitis internus minor, or *rectus anticus minor*, trachelo-fous-occipitien; a small muscle of the head, lying under the last, short, narrow, and flattened, and extending from the atlas to the occiput. It is covered in front by the *rectus internus major*, the internal carotid artery, and the great sympathetic nerve: behind it covers the capsule of the articulation between the atlas and occiput. The outer and inner edges present nothing remarkable. Its lower extremity is fixed to the anterior surface of the lateral portion of the atlas, and to the neighbouring part of its transverse process. Thence it ascends, increasing somewhat in size, and inclined a little inwards, and is fixed to the under surface of the basilar process of the occiput, behind and a little on the outside of the *rectus internus major*, and to the cartilaginous mass filling the space between the occipital and temporal bones. It has aponeuroses at its extremities, and very short muscular fibres between these.

Its action on the head is exactly the same with that of the *rectus internus major*.

RECTUS capitis lateralis, le premier transverseur antérieur Winslow, atloïdo-mastoldien, petit droit latéral; a small muscle of the head, situated at the upper and lateral part of the neck, flattened and quadrilateral, reaching from the transverse process of the atlas to the occiput. It is covered in front by the internal jugular vein; and it covers behind the vertebral artery. The two edges present nothing remarkable. Below it is fixed to the front of the upper surface of the transverse process of the atlas: thence it ascends a little outwards, and is attached above to the rough impression behind the jugular fossa. It is muscular, except just at the attachments, which are tendinous. Its action, like that of the two last muscles, is to restore the head, when it has been bent backwards: to bend it forwards; and, when one muscle acts singly, to incline it laterally.

RECTUS capitis posterior major, axoïdo-occipitien; a muscle of the head, of a triangular flattened figure, placed at the upper and back part of the neck, and extending from the spinous process of the second cervical vertebra to the occiput. Its posterior surface is covered by the complexus, and above by the *obliquus superior capitis*; the anterior surface covers the posterior arch of the atlas, the *rectus posterior minor*, and the occiput. The inferior extremity, narrow, and almost pointed, is attached to the spinous process of the second cervical vertebra, thence it ascends, directed outwards, and a little backwards, and gradually increasing in breadth, to be inserted in the inferior surface of the occiput, at about an equal distance from the great external transverse ridge, and the foramen magnum, between the complexus, the *obliquus superior*, and the *rectus posterior minor*. The extremities alone are tendinous; the rest being muscular. It restores the head, when it has been bent forwards; and carries it back on the vertebral column. When one muscle acts singly, it will have the power, from the oblique direction of its fibres, of rotating the head, so as to turn the face towards its own side.

RECTUS capitis posterior minor, atloïdo-occipitien; a small flattened muscle with radiated fibres, and consequently a triangular figure, placed at the upper and back part of the neck, extending from the atlas to the occiput, and lying with its fellow in the interval between the two *recti majores*. Its posterior surface is inclined downwards and covered by the complexus; the anterior surface corresponds to the occiput, and to the interval between it and the atlas. The lower extremity is the narrowest part, and is fixed to the rough impression in the middle of the pos-

terior surface of the posterior arch of the atlas: it ascends parallel to the opposite muscle and directed backwards, and is fixed to the external surface of the occipital bone at a short distance from the foramen magnum. It raises the head when bent forwards; and extends it or carries it back on the neck.

RECTUS cruris, *rectus extensor* or anterior *cruris*, droit ou grêle antérieur, ileo-rotulien; a muscle of the thigh, long and flat, broad in the middle, and narrow towards its extremities, occupying the middle and front part of the limb, and reaching from the anterior and inferior spine of the ilium to the patella. It is covered in front by the *iliacus internus*, the *Sartorius*, and the *fascia lata*; behind it covers the orbicular ligament of the hip, the great extensors of the knee, and the external or anterior circumflex vessels. The outer and inner margins of the muscle are unattached in their upper three-fourths; they are confounded, in their lower fourth, with the extensors of the knee.

The superior extremity of the *rectus cruris* presents two tendons, one of which is straight, the other curved. The former is fixed to the anterior and inferior spine of the os innominatum: the latter, curved from before backwards, and from above downwards, is fixed to the outer surface of the os innominatum for about an inch, immediately above the edge of the acetabulum. From this upper attachment the muscle descends vertically in front of the thigh, growing broader to the middle of the limb; it then becomes narrow towards the lower part, and is fixed to the basis of the patella.

The *rectus* is tendinous at its extremities, and fleshy in the middle. The upper tendon has been already described as divided into two portions; the anterior of these, attached to the anterior and inferior spine of the os innominatum, is the thickest and shortest, and has the same direction as the muscle; the other is longer and curved, and detaches some fibres to strengthen the orbicular ligament of the hip. The two portions soon unite in a common tendon; this spreads out into a broad aponeurosis, which descends about four inches on the front of the muscle, and then dips into its substance. The inferior tendon is broad and flat, and rises from the basis of the patella; its posterior surface is united to the great extensors of the knee, and the edges are strongly connected to the *vastus externus* and *internus*. It is broad at the patella, grows a little narrower as it rises, then spreads out again, and forms a broad aponeurosis, covering the back of the muscle above its middle. The superficial fibres of this tendon descend over the front of the patella, to which they are strongly united, and are lost below in the tendon which unites this bone to the tibia. The muscular fibres are placed very obliquely between the superior and inferior tendons: they cover the back of the first up to the part where its two portions separate; and they descend on the front of the second to within two inches of the patella.

It extends the knee-joint, either by bringing the leg forwards upon the thigh, or the thigh upon the leg, according as the one or the other part is rendered a fixed point. If the knee be extended, or firmly retained in the bent position by its flexor muscles, the *rectus* may bend the thigh upon the pelvis: when the leg and thigh are fixed, it can bend the pelvis forwards upon the latter, as in the attitude of stooping to pick up any object from the ground. In the erect attitude it prevents the pelvis from inclining backwards; and restores it when it has been carried in that direction.

RECTUS in curia, in *Latu*, one who stands at the bar, and no man objects any thing against him.

When

When a man hath reved the outlawry, and can participate of the benefit of the law, he is said to be *rectus in curia*.

RECVLVER, in *Geography*, a village and parish in the upper half-hundred of Blean-Gate, lathe of St. Augustine, and county of Kent, England, is situated at the distance of 10 miles N.E. by N. from Canterbury. It is noted in history as the site of the Roman *Regulbium*, the station or castle which defended the northern entrance to the celebrated *Portus Rutupensis*. It is remarkable, that while the ocean has receded from the southern entrance, leaving Richborough (Rutupium) considerably inland, it has gradually advanced upon Reculver. This is proved on the authority of several ancient writers, particularly Leland, who states, that in his time it stood about half a mile from the shore, whereas, at present, the tide washes the walls of many of the village houses, and threatens to overwhelm the whole at no distant period. Regulbium was a station of much importance, as it not only commanded an extensive view of the open sea, but likewise of the mouths of the Thames and the Medway. It was therefore used as a watch-poll to discover the approaches of an enemy; and also as a light-house to guide sailors. In its perfect state the station was of a square form, with the angles rounded off, and was environed by a ditch exterior to the walls, of which a considerable portion still remains. The extent of the inclosed area from east to west is about 190 yards, and from south to north about 198 yards. The ancient town was without the station, and is supposed to have stood towards the north, on that part of the coast long since swallowed up by the waves: "and from the present shore, as far as a place called Black Rock, seen at low water mark, where, according to tradition, a church once stood, there have been found great quantities of tiles, bricks, fragments of walls, tessellated pavements, and other marks of a ruined town; and remains of the household furniture, drefs and equipment of the horses belonging to its inhabitants, are continually met with among the sands; for after the fall of the cliffs, the earthen parts of them being washed away, these metal-line substances remain behind." When a part of the cliff here fell down about the conclusion of the seventeenth century, a number of small vaults, arched over, and several cisterns, were discovered. The latter were all of the same figure, namely, square, and measured from ten to twelve feet in length each side, and the same in depth. They were constructed of posts, driven deep into the ground, with planks two inches thick fixed to them. Their use was evidently the reception and preservation of rain water, which the Romans thought more wholesome than spring water. Vast quantities of Roman coins have been discovered both in the fields and along the shore here; and Du Fresne has produced many, which, from the markings upon them, appear to have been struck at a mint in this place. British and Gaulish coins are likewise occasionally found here; also seals, keys, spoons, gold rings, bracelets, signets, bullae, belts, bridles, harness, beams of scales or stiliards, and many other articles of which the use has not yet been determined.

When Kent was subdued by the Saxons, Regulbium became a principal seat of the monarchs of that dynasty. It was then called *Raculf* and *Raculf-cesler*; and hither king Ethelred retired with his court, after his conversion to Christianity by St. Augustine. In the next century it obtained the name of Raculf-minster, from a Benedictine abbey founded here by Baffa, a priest and nobleman, to whom lands were granted for that purpose by king Egbert, as an atonement for the murder of his two nephews. This abbey was dissolved previous to the Conquest, having probably

been destroyed by the Danes. The town, however, continued in a flourishing condition for many years after that event, and had the privilege of a weekly market granted to it in 1313; but this right has been long discontinued. The church here is an ancient and spacious edifice, consisting of a nave, with two aisles, a chancel, and two lofty towers, surmounted by spires at the angles of the west front. The nave is separated from the aisles by five pointed arches, rising from short oblong piers; and from the chancel by three small semi-circular arches, springing from tall round columns, with very singular capitals. In this church kings Ethelbert I. and II. are said to have been buried; and a monument erected to the memory of the first is described by Weever in his "Funeral Monuments," though it has now disappeared. On the floor of the chancel are several brasses of great antiquity. (See **RICHBOROUGH**.) *Beauties of England and Wales*, vol. vii. by E. W. Brayley. *History and Antiquities of Reculver and Herne*, by W. Brayley, D. D. 8vo.

RECUMPADO, in *Geography*, a town of Hindostan, in the circle of Rajamundry; 23 miles N.W. of Rajamundry.

RECUPERATORES, among the Romans, were commissioners appointed to take cognizance of private matters in dispute, between the subjects of the state and foreigners, and to take care that the former had justice done them.

It came at last to be used for commissioners, to whom the praetor referred the determination of any affair between one subject and another.

RECURRENS, in *Anatomy*, a name under which the inferior laryngeal branch of the par vagum is often described, from the circumstance of its arising in the chest below the point of its distribution to the larynx, and then going back into the neck in a retrograde course. See **NERVE**.

RECURRING SERIES, is a series so constituted, that each succeeding term is connected with a certain number of the terms immediately preceding it, by a certain and invariable law; as the sums or differences of some multiples of those terms. Thus the series

$$\alpha \quad \beta \quad \gamma \quad \delta \quad \epsilon \quad \theta \quad \&c. \\ 1, \quad 3x, \quad 5x^2, \quad 7x^3, \quad 9x^4, \quad 11x^5, \quad \&c.$$

is a recurring series; for these terms being respectively represented by $\alpha, \beta, \gamma, \delta, \epsilon$, &c. we have

$$\begin{aligned} \gamma &= 2x\beta - x^2\alpha \\ \delta &= 2x\gamma - x^2\beta \\ \epsilon &= 2x\delta - x^2\gamma \\ \theta &= \&c. \quad \&c. \end{aligned}$$

that is, each term is equal to $2x$ times that which precedes it, minus x^2 times the one preceding the last.

Or, generally, let

$$\alpha \quad \beta \quad \gamma \quad \delta \quad \epsilon \quad \theta \quad \&c. \\ a, \quad bx, \quad cx^2, \quad dx^3, \quad ex^4, \quad fx^5, \quad \&c.$$

be any series whose terms are denoted as above, by $\alpha, \beta, \gamma, \delta, \epsilon$, &c. Also, let μ, ν, ϵ , &c. represent the successive multipliers by which the terms are connected, so that

$$\begin{aligned} \alpha &= \alpha \\ \beta &= \beta \\ \gamma &= \mu x\beta + \nu x^2\alpha + \&c. \\ \delta &= \mu x\gamma + \nu x^2\beta + \&c. \\ \epsilon &= \mu x\delta + \nu x^3\gamma + \&c. \\ \theta &= \&c. \quad \&c. \end{aligned}$$

then this series is called a recurring series; and $\mu + \nu + \&c.$ De Moivre calls the *scale of relation*, which is said to be of *one, two, three*, &c. terms, according to the number of multipliers

RECURRING SERIES.

multipliers by which it is connected. In the above we have used only two, μ and ν , whence $\mu + \nu$ is called the scale of relation, which is here of two terms; and 1 minus the scale of relation, as $1 - \mu - \nu$, is called by the same author the *differential scale*, which is always equal to the denominator of the fraction from which the series is produced.

If, in the above series, the terms had the relation

$$\begin{aligned}\alpha &= \alpha \\ \beta &= \beta \\ \gamma &= \gamma \\ \delta &= \mu x \cdot \gamma + \nu x^2 \cdot \beta + \epsilon x^3 \cdot \alpha \\ \epsilon &= \mu x \cdot \delta + \nu x^2 \cdot \gamma + \epsilon x^3 \cdot \beta \\ \theta &= \mu x \cdot \epsilon + \nu x^2 \cdot \delta + \epsilon x^3 \cdot \gamma \\ \&c. & \quad \&c. \quad \&c.\end{aligned}$$

then the scale of relation would be $\mu + \nu + \epsilon$, which is of three terms; and the differential scale, or the denominator of the fraction, is $1 - \mu - \nu - \epsilon$.

The following problems are naturally connected with the doctrine of recurring series; *viz.*

1. Any recurring series being proposed, to find the scale of relation, or the law of the series, which is not always obvious on inspection.

2. To find the sum of an infinite recurring series, or the sum of any number of its terms (n).

3. To find a general expression for any indefinite term of such a series, as, for example, the n th term.

We shall consider each of these problems under their separate heads.

I. *To find the scale of relation in any proposed recurring series.*

Let $\alpha, \beta, \gamma, \delta, \epsilon, \theta, \&c.$ be a recurring series, of which it is required to find the scale of relation

$$\begin{aligned}\text{Assume} \quad \delta &= \mu' \gamma + \nu' \beta + \&c. \\ \epsilon &= \mu' \delta + \nu' \gamma + \&c. \\ \theta &= \&c. \quad \&c.\end{aligned}$$

Where $\beta, \gamma, \delta, \&c.$ are known, and $\mu, \nu, \&c.$ unknown quantities, whose numeral values are required, and which are readily found by the usual method of elimination. Thus in the above, using only μ and ν , we have

$$\mu' = \frac{\delta \gamma - \epsilon \beta}{\gamma \gamma - \delta \beta}, \text{ and } \nu' = \frac{\delta \delta - \gamma \epsilon}{\beta \delta - \gamma^2}.$$

These values of μ' , and ν' , will obviously contain in them the powers of the indeterminate quantity x , which being taken out, we shall have the required numeral values of μ and ν .

Let it be required to ascertain the scale of relation in the series

$$\begin{array}{ccccccc}\alpha & \beta & \gamma & \delta & \epsilon & \theta & \&c. \\ 1, & 3x, & 5x^2, & 7x^3, & 9x^4, & 11x^5, & \&c.\end{array}$$

Here, by substituting the proper values of $\beta, \gamma, \delta, \&c.$ in the above equation, we have

$$\begin{aligned}\mu' &= \frac{35x^5 - 27x^5}{26x^4 - 21x^4} = \frac{8x^5}{4x^4} = 2x \\ \nu' &= \frac{49x^6 - 45x^6}{21x^4 - 25x^4} = \frac{4x^6}{-4x^4} = -1x^2\end{aligned}$$

when $\mu = 2$, and $\nu = -1$.

The same method may obviously be employed in any other case; but in order to know whether or not we have assumed a scale of relation of a sufficient number of terms, we must repeat the same operation upon three other terms, of which one at least was not before employed; and if both give the same values, we may be assured of the truth of our results: or we may otherwise, instead of repeating the operation, examine the several terms, and see whether they agree with the

law we have determined, and if not, we must increase the terms in our scale of relation; for it may be observed, that we can never fail of determining them in consequence of having assumed too many terms, as we shall, in that case, have one of our results zero.

Lagrange has formed a different rule for ascertaining whether a given series be recurring or not, which Mr. Bonycastle has given at p. 323 of his Algebra; but as it does not seem adapted for detecting the law of formation, we shall not insert it.

II. *To find the sum of any recurring series, of which the scale of relation is known.*

$$\text{Let } \begin{cases} \alpha & \beta & \gamma & \delta & \epsilon & \theta & \&c. \\ a, & bx, & cx^2, & dx^3, & ex^4, & fx^5, & \&c. \end{cases}$$

be a recurring series, of which the scale of relation is $\mu + \nu$, so that

$$\begin{aligned}\alpha &= \alpha \\ \beta &= \beta \\ \gamma &= \mu x \cdot \beta + \nu x^2 \cdot \alpha \\ \delta &= \mu x \cdot \gamma + \nu x^2 \cdot \beta \\ \epsilon &= \mu x \cdot \delta + \nu x^2 \cdot \gamma \\ \&c. & \quad \&c. \quad \&c.\end{aligned}$$

Here it is obvious, that the whole sum

$$\begin{aligned}S &= \alpha + \beta + \gamma + \delta + \epsilon + \theta + \&c. \\ S &= \alpha + \beta + \mu x (\beta + \gamma + \delta + \epsilon + \theta + \&c.) + \nu x^2 (\alpha + \beta + \gamma + \delta + \epsilon + \theta + \&c.) \\ S &= \alpha + \beta + \mu x (S - \alpha) + \nu x^2 S\end{aligned}$$

$$\text{whence } S = \frac{\alpha + \beta - \mu \alpha x}{1 - \mu x - \nu x^2}$$

which is a general expression when the scale of relation is of two terms.

When the scale of relation is of three terms, so that

$$\begin{aligned}\alpha &= \alpha \\ \beta &= \beta \\ \gamma &= \gamma \\ \delta &= \mu x \cdot \gamma + \nu x^2 \cdot \beta + \epsilon x^3 \cdot \alpha \\ \epsilon &= \mu x \cdot \delta + \nu x^2 \cdot \gamma + \epsilon x^3 \cdot \beta \\ \theta &= \mu x \cdot \epsilon + \nu x^2 \cdot \delta + \epsilon x^3 \cdot \gamma \\ \&c. & \quad \&c. \quad \&c.\end{aligned}$$

it is equally obvious that

$$S = \alpha + \beta + \gamma + \delta + \epsilon + \theta + \&c. \text{ or}$$

$$S = \begin{cases} \alpha + \beta + \gamma + \\ \mu x (\gamma + \delta + \epsilon + \theta + \&c.) + \\ \nu x^2 (\beta + \gamma + \delta + \epsilon + \theta + \&c.) + \\ \epsilon x^3 (\alpha + \beta + \gamma + \delta + \epsilon + \theta + \&c.), \text{ or} \end{cases}$$

$$S = \alpha + \beta + \gamma + \mu x (S - \alpha - \beta) + \nu x^2 (S - \alpha) \epsilon x^3 + S$$

whence we have

$$S = \frac{\alpha + \beta + \gamma - \mu x (\alpha + \beta) - \nu x^2 \alpha}{1 - \mu x - \nu x^2 - \epsilon x^3}$$

which is the general expression for the sum, when the scale of relation is of three terms.

In the same manner we have

$$S = \frac{\alpha + \beta + \gamma + \delta - \mu x (\alpha + \beta + \gamma) - \nu x^2 (\alpha + \beta) - \epsilon x^3 \alpha}{1 - \mu x - \nu x^2 - \epsilon x^3 - \sigma x^4}$$

for a scale of relation of four terms; and so on.

But as the terms $\alpha, \beta, \gamma, \delta, \&c.$ contain in them certain powers of x , we may reduce the above expressions to simpler forms

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forms by substituting a for α , $b x$ for β , $c x^2$ for γ , &c. in which case the above become

$$S = \frac{a + (b - a\mu)x}{1 - \mu x - \nu x^2}$$

$$S = \frac{a + (b - a\mu)x + (c - b\mu - a\nu)x^2}{1 - \mu x - \nu x^2 - \xi x^3}$$

$$S = \frac{a + (b - a\mu)x + (c - b\mu - a\nu)x^2 - (d - c\mu - b\nu - a\xi)x^3}{1 - \mu x - \nu x^2 - \xi x^3 - \sigma x^4}$$

which are the several expressions for the scales of relation of two, three, or four terms, and the law of formation is sufficiently obvious for any other scale.

The same law might have been otherwise obtained as follows. It is evident, from what is done above, that the scale of relation subtracted from unity is always equal to the denominator of the generating series, and the same may also be demonstrated on other principles. In order, therefore, to find the numerator, we might assume the proposed series

$$a + b x + c x^2 + d x^3 + \&c.$$

$$= \frac{a' + b' x + c' x^2 + d' x^3 + \&c.}{1 - \mu x - \nu x^2 - \xi x^3 - \&c.}$$

then multiplying this denominator by the proposed series, and equating the co-efficients of the products with those of the like powers of x in the numerator, we should find

$$a' = a$$

$$b' = b - a\mu$$

$$c' = c - b\mu - a\nu$$

$$d' = \&c. \quad \&c.$$

as in the preceding formulæ.

It is only necessary to observe, farther, that if the indices of x do not follow the law we have supposed, we must make the necessary correction in the general expression, and if the proposed series have no power of x in it, as commonly happens, we must, in the conclusion, make $x = +1$.

The above formulæ, it will be observed, give the sum of the infinite series. When only a certain number of terms are to be summed, different formulæ are required, which we shall investigate, after having shewn how to obtain a general expression for the n th term of such recurring series. We propose, however, in the first place, to illustrate the above rules by one or two examples.

Exam. 1.—Required the sum of the infinite recurring series $1 + 6x + 12x^2 + 48x^3 + \&c.$ the scale of relation being $1 + 6$.

Here $a = 1$, $b = 6$, $\mu = 1$, and $\nu = 6$, whence

$$\frac{a + (b - a\mu)x}{1 - \mu x - \nu x^2} = \frac{1 + 5x}{1 - x - 6x^2}$$

the sum required.

Exam. 2.—Required the sum of the infinite recurring series

$$1 + 4x + 6x^2 + 11x^3 + 28x^4 + 63x^5, \&c.$$

the scale of relation being $2, -1, +3$.

Here $a = 1$, $b = 4$, $c = 6$; $\mu = 2$, $\nu = -1$, and $\xi = 3$; whence

$$S = \frac{a + (b - a\mu)x + (c - b\mu - a\nu)x^2}{1 - \mu x - \nu x^2 - \xi x^3} =$$

$$\frac{1 + (4 - 2)x + (6 - 8 + 1)x^2}{1 - 2x + x^2 - 3x^3} =$$

$$\frac{(1+x)^2 - 2x^2}{(1-x)^2 - 3x^3}$$

as required

III.—To find the general term of any proposed recurring series.

From the preceding part of this article it appears, that every recurring series may be considered as arising from the development or expansion of some rational fraction of the form

$$\frac{a + bx + cx^2 + dx^3 + \&c.}{1 - \alpha x - \beta x^2 - \gamma x^3 - \delta x^4 - \&c.}$$

Let us, therefore, suppose this fraction to be converted into the infinite recurring series $A + Bx + Cx^2 + Dx^3 + Ex^4 + \&c.$ of which we already know how to determine the co-efficients, and the law of their formation.

Now if this rational fraction be decomposed into its simple fractions by the method explained under the article *RATIONAL FRACTIONS*, and each of these simple fractions be then converted into a recurring series, it is evident that the sum of all these series ought to be equal to the original series

$$A + Bx + Cx^2 + Dx^3 + Ex^4 + \&c.$$

Now each of these partial fractions being of the form

$$\frac{A'}{1 - rx},$$

the series thence arising will have the form

$$A' + A'r x + A'r^2 x^2 + A'r^3 x^3 \dots A'r^n x^n$$

of which $A'r^n x^n$ is the general term. Hence, the several series arising from the partial fractions may be supposed to be

$$A' + A'r x + A'r^2 x^2 + A'r^3 x^3 \dots A'r^n x^n$$

$$A'' + A''r' x + A''r'^2 x^2 + A''r'^3 x^3 \dots A''r'^n x^n$$

$$A''' + A'''r'' x + A'''r''^2 x^2 + A'''r''^3 x^3 \dots A'''r''^n x^n$$

$$A^{iv} + A^{iv}r''' x + A^{iv}r'''^2 x^2 + A^{iv}r'''^3 x^3 \dots A^{iv}r'''^n x^n$$

and since the sum of these series is equal to the original one proposed, we know that the co-efficients of the like powers of x are also equal, whence we have

$$A = A' + A'' + A''' + A^{iv} + \&c.$$

$$B = A'r + A''r' + A'''r'' + A^{iv}r''' + \&c.$$

whence it appears that the co-efficient of any term x^n of the recurring series is equal to the sum of the co-efficients of the same power of x , which arise from expanding the several simple fractions into which the given fraction is decomposed; and this co-efficient is always equal to the sum of each of the numerators of the several simple fractions, multiplied into the n th power of the corresponding value of r in the denominator of the same fraction, at least while the denominator contains no equal factor. But if, among the partial fractions,

there is any one of the form $\frac{A'}{(1 - rx)^3}$, the general term of

this will be $(n + 1) A r^n x^n$; of $\frac{A}{(1 - rx)^3}$, the general

term is $\frac{(n + 1)(n + 2)}{1 \cdot 2} A r^n x^n$; and universally $\frac{A}{(1 - rx)^k}$,

the general term is

$$\frac{(n + 1)(n + 2)(n + 3) \dots (n + k - 1)}{1 \cdot 2 \cdot 3 \dots (k - 1)}$$

we may, therefore, in all cases wherein the generating fraction of the original series admits of a rational decomposition, arrive very readily at the general term upon the principles above explained.

Thus,

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Thus, as an example, let there be proposed the recurring series

$$1 + 4x + 14x^2 + 46x^3 + 146x^4 + \&c.$$

to find the general term, or the co-efficient of x^n .

The sum of this series is found by the preceding part of this article to be $\frac{1-x}{1-5x+6x^2}$.

This rational fraction is equal to $\frac{-1}{1-2x} + \frac{2}{1-3x}$. Now

the general term of $\frac{1}{1-2x}$ is $-2^n x^n$; and of $\frac{2}{1-3x}$ is $-2 \cdot 3^n x^n$, as shewn above, therefore the general term of the proposed series will be $(2 \cdot 3^n - 2^n) x^n$.

It may be observed, however, that this method is in some cases very laborious, and not always practicable; it will, therefore, frequently be better to make use of the *multinomial theorem*, which may be done by putting the generating fraction under the form

$$(a + bx + cx^2 + \&c.) (1 - \alpha x - \beta x^2 - \gamma x^3 - \&c.)^{-1}$$

See *Multinomial Theorem*.

IV.—To find the sum of any number (n) terms of a recurring series.

For this purpose it is only necessary to find the co-efficient of the $n+1$ th term of the series. Then, from the sum of the entire series subtract the sum of the series beyond the n th term, and the difference will obviously be the sum of the first n terms sought.

Let there be proposed as an example to find the sum of n terms of the series

$$1 + 2x + 3x^2 + 4x^3 + \dots + nx^{n-1}.$$

The infinite sum of this series is readily found $= \frac{1}{(1-x)^2}$.

In the second case, viz. of the terms beyond nx^{n-1} , the series is

$$(n+1)x^n + (n+2)x^{n+1} + (n+3)x^{n+2} + \&c.;$$

and in the formula $s = \frac{\alpha + \beta - \alpha\mu x}{1 - \mu x - \nu x^2}$ we have only to sub-

stitute $\alpha = (n+1)x^n$, and $\beta = (n+2)x^{n+1}$, instead of $\alpha = 1$ and $\beta = 2x$, as in the former. Hence we have

$$s' = \frac{(n+1)x^n + (n+2)x^{n+1} - 2(n+1)x^{n+1}}{1 - 2x + x^2}, \text{ or}$$

$$s' = \frac{(n+1)x^n - nx^{n+1}}{(1-x)^2};$$

and, therefore, $s - s'$, or the sum of the first n terms is equal to

$$\frac{1 - (n+1)x^n + nx^{n+1}}{(1-x)^2}.$$

2. Required the sum of n terms in the series

$$1 + 3x + 5x^2 + 7x^3 + \dots + (2n-1)x^{n-1}.$$

Here, by trial, we find the scale of relation to be $\mu = +2$, and $\nu = -1$, as before, therefore the infinite sum is

$$s = \frac{\alpha + \beta - \alpha\mu x}{1 - \mu x - \nu x^2} = \frac{1 + 3x - 2x}{1 - 2x + x^2} = \frac{1+x}{(1-x)^2}.$$

After n terms, the series becomes

$$(2n+1)x^n + (2n+3)x^{n+1} + (2n+5)x^{n+2} + \&c.$$

which therefore arises from the fraction

$$\frac{(2n+1)x^n + (2n+3)x^{n+1} - 2(2n+1)x^{n+1}}{1 - 2x + x^2} =$$

$$\frac{(2n+1)x^n - (2n-1)x^{n+1}}{(1-x)^2}$$

whence the sum of n terms is

$$\frac{1+x - (2n+1)x^n + (2n-1)x^{n+1}}{(1-x)^2}$$

3. Required the sum of n terms of the series

$$(n-1)x + (n-2)x^2 + (n-3)x^3 + \&c.$$

Here again the scale of relation is $+2-1$, therefore the infinite sum is

$$\frac{(n-1)x + (n-2)x^2 - 2(n-1)x^3}{(1-x)^2} = \frac{(n-1)x - nx^2}{(1-x)^2}.$$

After n terms, it becomes $-x^{n+1} - 2x^{n+2} - \&c.$ the sum of which is found in the same manner to be $-\frac{x^{n+1}}{(1-x)^2}$; there-

fore n terms of the proposed series is

$$\frac{(n-1)x - nx^2 + x^{n+1}}{(1-x)^2}$$

Hence, also, n terms of the series

$$\frac{(n-1)x}{n} + \frac{(n-2)x^2}{n} + \frac{(n-3)x^3}{n} + \&c. \text{ is } \frac{(n-1)x - nx^2 + x^{n+1}}{n(1-x)^2}$$

In a similar manner the sum of n terms of the series

$$1^2 + 2^2x + 3^2x^2 + 4^2x^3 + \&c.$$

is found to be

$$\frac{1+x - (n+1)^2x^n + (2n^2+2n-1)x^{n+1} - n^2x^{n+2}}{(1-x)^3}$$

the scale of relation being $3-3, 1$.

In all the preceding examples we have determined the infinite sum of the series, as beginning at the first term, and at the $(n+1)$ th term, a more easy method is as follows, which is due to Simpson. Essays, p. 96.

Let $A + B + C + D + \dots + K + L + M + N$ be any finite recurring series, of which each term depends upon the three which precede it, the scale of relation being p, q, r , so that

$$\begin{aligned} pA + qB + rC &= D \\ pB + qC + rD &= E \\ \&c. \quad \&c. \quad \&c. \end{aligned}$$

or, which is the same,

$$\begin{aligned} pA + qB + rC - D &= 0 \\ pB + qC + rD - E &= 0 \\ pC + qD + rE - F &= 0 \\ pK + qL + rM - N &= 0 \end{aligned}$$

whence,

whence, by addition

$$\frac{p(A+B+C+\dots K) + q(B+C+D+L) + r(C+B+D+\dots M) - (D+E+F+N)}{r(C+B+D+\dots M) - (D+E+F+N)} = 0$$

Or, representing the whole sum by S ,

$$\frac{p(S-L-M-N) + q(S-A-M-N) + r(S-A-B-N) - (S-A-B-C)}{r(S-A-B-N) - (S-A-B-C)} = 0$$

which, by addition and division, gives

$$S = \frac{p(L+M+N) + q(A+M+N) + r(A+B+N) - (A+B+C)}{p+q+r-1}$$

where the sum depends merely upon the three first and the three last terms of the series; and a similar expression, it is obvious, may be obtained for any other scale of relation.

It may not be amiss to observe, that when the proposed series is wholly numeral, (the sum of which, as we have before observed, is to be found by making $x=1$); both this formula and the preceding one fail, in the case in which the denominator of the fraction becomes zero, and we must, therefore, in such cases, have recourse to other methods of summation, as given under the article *SERIES*.

On this subject the reader should consult De Moivre's *Misc. Analyt.* and his *Doctrine of Chances*, and Euler's *Analysis Infinitorum*, where he will find an explanation of its application to the approximation to the roots of equations. Colson's *Comment on Newton's Fluxions*. Stirling's *Methodus Differ.* Cramer's *Analysis des Lignes Courbes*. Bernoulli de *Serieb. Inf. &c.* See also a chapter on this subject, in vol. ii. of Bonnycastle's *Algebra*.

RECURVIROSTRA, the *Avocet*, in *Ornithology*, a genus of birds of the order *Grallæ*, of which the generic character is; bill depressed, subulate, recurved, pointed, flexible at the tip; the feet are palmate, four-toed, the hind toe not connected, very short, and placed high up; the nostrils are narrow, pervious; the tongue is short. There are only three

Species.

* **AVOCETTA**; Scooping Avocet; called also in different parts of this country, butter-slip, scooper, yelper, crooked-bill, &c. This bird is variegated with white and black; the bill is three inches and a half long; irides hazel; crown black; a white spot behind and beneath the eyes; rest of the head, neck, back, exterior part of the wings, lesser quill-feathers, tail, and under part of the body, white; inner scapulars and greater quill-feathers without and at the tips black; legs blueish, and very long; membrane connecting the toes indented. It resides in the temperate parts of Europe, weighing thirteen ounces; and measuring, from the tip of the bill to the end of the tail, eighteen inches. It breeds in the fens of Lincolnshire, and on Romney Marsh, in Kent. The female lays two white eggs, tinged with green, and marked with large black spots. In winter these birds assemble in small flocks of six or seven, and frequent the shores, particularly the mouths of large rivers, in search of worms and marine insects, which they scoop out of the mud or sand. They seem to be particularly fond of the cancer, pulex, or locusta. By means of their long legs, they run over shores that are covered five or six inches with water. In their movements they are lively, alert, volatile, and difficult to catch. When the female is frightened off her nest she counterfeits lameness; and when a flock is disturbed, they fly with their necks stretched out, and their legs extended behind, over the head of the spectator, mak-

ing a shrill noise, and uttering a yelping cry of twit, twit, all the time.

AMERICANA; American Avocet. The head and neck are reddish; back black, beneath it is white. It inhabits North America and New Holland; is fourteen inches long. Bill black; front dusky-white; neck above white; primary and tertial wing-coverts black, the middle ones, and some of the secondary quill-feathers, white.

ALBA; White Avocet. This species is white; the lower wing-coverts brownish; bill orange; legs brown. Inhabits Hudon's Bay; fourteen inches and a quarter long. Bill tipped with black; edge of the wings, greater quill-feathers, and tail, tinged with yellowish.

RECUSANTS, in a general sense, persons, whether Papists or others, who refuse to go to church and to worship God after the manner of the church of England. Popish recusants are Papists, who so refuse; and a popish recusant convict is a Papist legally convicted of such offence. See **PAPIST**, **PREMUNIRE**, and **TOLERATION**.

RECUSATION, **RECUSATIO**, an act by which a judge is desired to refrain from judging some certain cause, on account of his relation to one of the parties; or of some capital enmity, or the like.

By the French laws, kinship within the fourth degree is deemed a legal cause of recusation; as also the judge's being godfather, &c. of one of the parties.

By the laws of England also, in the times of Bracton and Fleta, a judge might be refused for good cause; but now the law is otherwise, and it is held that judges or justices cannot be challenged. *Co. Litt.* 254. See **CHALLENGE**.

RED, in *Physics*, one of the simple or primary colours of natural bodies, or rather of the rays of light.

The red rays are those which are of all rays the least refrangible: hence, as sir Isaac Newton supposes the different degrees of refrangibility to arise from the different magnitudes of the luminous particles of which the rays consist, the red rays, or red light, is concluded to be that which consists of the largest particles. See **COLOUR**, **LIGHT**, and **RAY**.

Authors distinguish three general kinds of red; one bordering on the blue, as colombine, or dove-colour, purple, and crimson; another bordering on yellow, as flame-colour and orange; and between these extremes is a medium, partaking neither of the one nor the other, which is what we properly call *red*.

Acids generally turn black blue, and violet into red; and red into yellow, and yellow into a very pale yellow.

Alkalies change red into violet, or purple; and yellow into feuillemort, or dead leaf-colour.

Terrestrial and sulphureous matters become red by extreme heat; and some, at length, black, as we see in brick, red bole, red chalk, slate, &c. All these, when vitrified by a burning-glass, become black.

Lobsters become red by a moderate fire; and by a violent one, black. Mercury and sulphur mixed and heated over a moderate fire make a beautiful red, called *artificial cinnabar*.

An acid spirit, as lemon juice, being poured on a blue solution of turnsole, turns it into a beautiful red. Alkali restores it again to its original blue. Filtrating of some reddish wines takes from them all their red colour.

M. De la Hire observes, that a very luminous body viewed through a black one, always appears red; as when the sun is seen shining through a black cloud. He adds, that some people who see all the other colours perfectly well, yet have no idea of red, and only see it as black.

RED, in *Cosmetics*, a fucus or paint with which the ladies enliven their cheeks and lips.

There

There are two kinds of reds; the one in leaves, called Spanish red; the other a liquor, which is an extract of a scarlet dye.

RED, in *Dyeing*, is one of the five simple or mother colours of the dyers.

Some reckon seven kinds, or casts of red: *viz.* scarlet-red, crimson-red, madder-red, half-grain-red, half-crimson-red, lively orange-red, and scarlet of cochineal. But they may be all reduced to three, according to the three principal drugs which give the colours; which are kermes, cochineal, and madder.

The fine scarlet, called *scarlet of the Gobelins*, is given with agaric, bran-water, woad, and scarlet grain, or kermes. Some dyers add cochineal, and others fenugreek; brightening it with bran-water, agaric, tartar, and turmeric. See KERMES and SCARLET.

Crimson-red is dyed with bran-water, tartar, and mellelique cochineal. See CRIMSON.

Madder-red is dyed with madder; to which some add realgar, or red arsenic: others, common salt, or other salts, with wheat-flour; or agaric with spirit of wine, with galls or turmeric. See MADDER.

The half-grain is made with agaric and bran-water, half scarlet grain, half madder, and sometimes turmeric.

The half-crimson is made of half madder, half cochineal. As to the lively orange-red, the stuff must be first put in yellow, then in a liquor made of goat's hair, (which has been boiled several times with madder,) dissolved over the fire with certain saline liquors, as urine, tartar, &c.

The scarlet of cochineal, or Dutch scarlet, as the French call it, is made with starch, tartar, and cochineal; after first boiling it with alum, tartar, sal gemma, and aqua fortis in which pewter has been dissolved.

Besides these seven reds, which are good and allowed colours, there is also a Brasil red; which is discouraged, as fading easily.

Of the seven good reds, only four have particular casts, or shades; the madder-red, crimson-red, lively orange-red, and scarlet of cochineal.

The casts or shades of crimson are flesh colour, peach colour, carnation rose colour, and apple-tree flower colour. Those of madder are flesh colour, onion-peel colour, and flame colour. Those of orange are the same with those of crimson. Scarlet, besides the shades of all the rest, has some peculiar to itself, as cherry colour, fire colour, &c. See DYEING.

RED, in the *Manufacture of Glafs*. See RED GLASS.

To make a deep red in glafs, the following method is that most practised by the glafs-men. Take crystal frit twenty pounds, broken pieces of white glafs one pound, calcined tin two pounds; mix these well together, and put them into a pot to melt and purify. When these are melted, take steel calcined, scales of iron from the smith's anvil, both powdered very fine, of each an equal quantity; put leisurely an ounce of this mixed powder to the before mentioned metal; mix all well together, and let them stand six or eight hours in fusion to incorporate; take out a proof after this, and if there be too little of the powder, it will appear of a dusky yellow; then more of the powder must be added, and then add three quarters of an ounce of calcined brass, ground to a fine powder; mix them thoroughly together, and the mass will be of a blood red; continue stirring the whole together, and frequently taking out proofs of the colour, when it is right, work it immediately, otherwise it will lose its colour and become black. The mouth of the pot must in this process be left open, else the colour will be lost. Neri's Art. of Glafs, p. 100.

RED, in *Heraldry*. See GULES.

RED, in *Painting*. For painting in oil colours they use a red called *cinnabar*, or vermilion; and another called *lacca*. See each in its place.

In limning and fresco, for a violet red, instead of lacca they use reddle, a natural earth found in England; for a brown red, they use burnt ochre, which is a native yellow earth, made red by calcination. It is chiefly brought from Oxfordshire; and burnt by those who prepare it in large ovens. The marks of its goodness are brightness of colour, and a friable chalky texture, without manifesting any gritty roughness when rubbed betwixt the fingers.

The common Indian red, which is of a hue verging to the scarlet, is much used, on account of its standing and warm though not bright colour, in finer as well as coarser paintings in oil. It may be prepared by taking of the caput mortuum or ochre left in the iron pots after the distillation of aqua fortis from nitre and vitriol, two parts; and of the caput mortuum or colcothar left in the long necks after the distillation of oil of vitriol, one part; breaking the lumps found among them, and putting them into tubs with a good quantity of water: and having left them to stand for a day or two, frequently stirring them, then lading off as much water as can be obtained clear from them, and adding a fresh quantity; repeating the same treatment till all the salts be washed out, and the water comes off nearly insipid. The red powder which remains must then be washed over, and, being freed from the water, laid out to dry. When this is designed for nicer purposes, it should again be washed over in basons.

The true Indian red is a native ochreous earth of a purple colour, brought from the island of Ormus, in the Persian gulf; and called, among the authors on these subjects, *terra Persica*. At present it is very rarely to be found; but it is certainly very valuable (there being no other uncompounded purple colour in use with oil) as well for the force of its effect, as for the certainty of its standing. In its genuine state, it needs no other preparation than grinding or washing over. It may be easily distinguished from any fictitious kind, by its being more bright than any other ochre which can be made so purple; and if it be rendered artificially purple by any addition, the fire will soon betray it; into which the genuine may be put without any hazard of change.

Venetian red is a native red ochre (see VENETA bolus), not much different from the common Indian red, but fouler; and may be easily prepared, by mixing common red ochre with the colcothar or caput mortuum taken out of the aqua fortis pots, and washed over. As it is generally used by the house painters in imitation of mahogany, it requires no other preparation than to be well ground with the oil with which it is used; but when it is used in miniature painting, it should be carefully washed over.

RED, *Blown*, in the *Porcelain Manufacture*, a name given to a peculiarly coloured china ware, of a spangled red, or to the colour alone that spangles it. It is an ornament easily introduced into use in our own manufactories of porcelain ware, and is done in the following manner. The colour is to be prepared of common copperas, calcined to a red colour in a charcoal fire, in a crucible, with another luted on the top of it inverted, and with a hole in its bottom. The signal of the calcination being finished, is, when the black clouds cease to come up through the hole, and a fine white thin vapour rises in their place. The vessels are to be then suffered to cool, and the red matter in them is to be reduced to a fine powder, while the vessels to be coloured with this

are yet wet. The operator is to provide a glass pipe, and covering one end of it with a piece of fine gauze, he is to dip this into the powder, and taking it carefully out, with what little is sticking to it, he is to blow against the vessel at some distance from it: thus the finest part of the powder only will reach the vessel, and will be laid on in form of glittering spangles, very small, but all distinct. This is sort of colouring much esteemed by the Chinese themselves, and they have a way of using the common blue in the same manner; but few of the vessels thus painted come over to us.

RED Clover, in *Agriculture*, an useful artificial grafs for arable lands. It has this name in contradistinction to the white and some other sorts. There were at first many and very great prejudices against and objections made to the introduction of this plant into cultivation by farmers, which were not surmounted without difficulty, and it prevailed for some length of time in particular districts, as Staffordshire and Worcestershire, before it was known in some other counties, where it is now very predominant and beneficial, as Cheshire, Lancashire, and many more.

In some arable counties red clover is found to fail as a crop when long cultivated, dying away in the winter and spring, which the farmers designate by saying that the land is sick of it. This is a severe inconvenience to them in many cases; and renders such variations in the courses of cropping necessary, as may prevent the recurrence of it so frequently as has hitherto been the case. It is very liable to fail in every part of the county of Essex, but of the cause of which there are different opinions, some thinking that the land becomes sick of the plant, while others do not ascribe it to any satiety of this nature, but alter their modes of cropping that it may not take place so often. About the Belcamps and Bosely this is very much the case, some venturing it only once in seven years, and in that case it succeeds well. In all the Tendring hundred it is found to decline little on the strong rich lands, but is felt on the lighter sorts; on both the cropping is varied in regard to it. In the neighbourhood of Thorndon the lands are sick of it. And at Audley End the land is tired of it, but more in many cases from want of sufficient feed than any thing else. In the vicinity of Haltingbury it is very liable to fail, if sown oftener than once in seven or nine years, though the system thereabouts is crop and fallow.

In the county of Oxford some sow red clover twice in ten years, the land being new to it; of course it never fails. On the gravelly loamy soils about Henly it dies from repetition, so that it is alternately omitted in cropping, others being substituted, as white clover, trefoil, and peas. Nothing of this sort was known forty years ago, but now they sow it only once in two rounds. The loams and stone-brash lands around Wood Raton are not in general tired of this plant; some however find it to fail on the latter sort of soil. About Great Tew, where the lands have been inclosed forty years, they are not yet tired of red clover. At Atterbury, where the lands have been inclosed more years, it does not now succeed quite so well as it did fifteen or twenty years ago. In these failures other crops are put in, as tares and early peas drilled.

Some suspect sheep's dung to be destructive to the red-clover plant, but there are no proofs of the fact.

The most proper management of red clover as a preparation for wheat is a matter of great importance. Some think feeding it off wholly the best practice; others mowing and feeding; and a few mowing altogether. The method of feeding off the crops altogether, when done in a close even manner, is probably the most advantageous in this

intention, though there may be some immediate loss and inconvenience; after which that of mowing the first crop and feeding the second in a useful manner; the third mode, or that of mowing twice, is most to be feared, but upon some sorts of land it may be done and answer well for wheat. These methods are all practised and have their advocates in different parts of Essex; and some think that they get as good wheat after white as red clover, as well as that feeding the latter does no injury in this respect.

The farmers in Oxfordshire follow nearly the same practices, and hold much the same opinions in regard to the management of this crop as a preparation for wheat. And the custom of mowing and feeding off the first year, is thought the best practice in some other counties.

But in the county of Lancaster, and some others adjoining it, they know nothing of the land being ever *sick* or *tired* of this sort of crop, though they grow it in more frequent succession and in a more full manner than perhaps any where else in the kingdom. Ask the farmers about this, from one end of the above county to the other, they are all of the same opinion, and appear much surprised at the question, not ever having any conception of such a circumstance. What can be the reason that red clover has been as long and as frequently cultivated in these districts, as in those where it is so liable to fail? Does it depend upon the difference in the nature or quality of the soils, or the management in regard to the quantity of seed and other matters? The circumstance is worthy of further and more close attention and investigation, in consequence of its great importance to the farmer.

There is one particular feature of management in the cultivation of red clover in the county of Oxford, which is that of hand-sowing over it from fourteen to fifteen bushels of Newbury peat-ashes, that are brought into the Thames, by the Reading canal, on the acre, about the end of February or the beginning of the following month; which has an immediate effect upon it, seldom failing to produce a crop, except where it naturally declines. The expence is estimated at about ten shillings the acre. These ashes do not, however, seem to be employed in this way to the red clover crop in the district where they are found and prepared.

Seeded red clover undergoes two successive threshings, the first, which only beats off the heads and chaffs containing the seed from the stalks, is called *cobbing* in some places; the parts thus separated being denominated the red-clover *cobb*. The work is performed on a thick wooden plank frame for the purpose, and requires much labour to separate the feed, which, when done, is cleaned and passed through different sieves, being ultimately divided into two sorts, the primary and secondary. The cost of these operations is very great, amounting to from four to six shillings the bushel, and sometimes much more. It has been concluded by Mr. Middleton, that this plant grows a full crop in all the arable lands of this country, from the sands of Norfolk to the clays of Cleveland and Sussex. And that various soils that have been exhausted by corn, and not much accustomed to red clover, have been so much restored by it, as to produce a good crop of wheat; but that to do this every means should be used to secure a full crop, as that is an excellent preparation for corn, and seldom fails of ensuring a considerable produce, arising from shade, smother, and putrefaction, the natural and constant attendants of full-grown red clover. It is supposed advisable, in some cases of poor land, to feed both crops off on the land by sheep and other animals, in some way or other. And sometimes to mow the first and feed the second, or the contrary. In every point of view this is an interesting plant to the farmer. See CLOVER.

RED Gum, an insect disease on wheat, by which the ears of the grain are deprived of their nutrition, and thereby prevented from perfecting themselves. It is described by Mr. Middleton to be a collection of insects, which are visible to the unassisted eye, and which, in the early part of their growth, are of a reddish colour, but become brown with age: the black spots on the straw, blades, and ears of the wheat, are supposed to be the excrement of the insects. The blighted ears are probably rendered so, by the insects piercing the necks of the straw immediately below them, and sucking the saccharine juice, otherwise destined for filling the corn. In those ears which have both perfect and imperfect grains, the insect has perhaps inserted its probe at the connection between the corn and the straw, and by drinking up the food of the grains severally, has starved many of them in such a manner as to cause their destruction and decay. The exact nature of the disease is not, however, yet well ascertained.

RED Hay, a term used to signify such as is mow-burnt, in opposition to such as is green from a moderate heat, and *winny hay*, or such as is mouldy.

RED Land, a term used by husbandmen to express a sandy soil of a reddish hue, interspersed for the most part with pieces of sand-stone of the same colour, or somewhat deeper.

It may be noticed that there are several varieties of this soil: one of which is almost entirely made up of sand; another with an admixture of loam with the sand, the whole making a loose loamy earth; and a third full of fragments of a poor sandy iron ore, and often containing shining specular of selenite. See **SOIL**.

In some of the more northern parts of the county of Oxford, there is a rich red sandy loam, upon a red grit-stone rock. In some places this land is of a more sandy quality than in others; and, in particular instances, a deep red loam, or red clay. The lands are mostly of an excellent quality, both for arable purposes and those of grass; but the sandy sorts are better than those of the clayey kinds, especially for the former use. The red soiled tracts in this district are considered as the boast and glory of the county, as they are deep, found, friable, and yet capable of tenacity; being well suited to almost every sort of plant which can be trusted to them, in the way of cultivation. Soils of this nature prevail more or less in a vast number of counties throughout the kingdom, even from the more southern ones to those far advanced towards the north.

RED Roan, a term signifying the red tinge in ripening barley, and sometimes other sorts of grain.

RED Row, a provincial term, applied to the grains of barley, when in a ripening state, or streaked with red. The crop is then said to be in the red row.

RED Antimony, in *Mineralogy*, an ore of that mineral, of a cherry-red colour, containing, according to Klaproth,

67.5 antimony,
10.8 oxygen,
19.7 sulphur.

It occurs most frequently in minute diverging capillary crystals. It melts and evaporates before the blowpipe, yielding a sulphureous odour. See **ANTIMONY**.

RED Arsenic. See **ARSENIC**.

RED Chalk. See **REDDLE**, and **Ores of IRON**.

RED Cobalt, called *cobalt crust*, and *cobalt bloom* or *ochre*, an ore of cobalt, of a peach blossom red colour. See **COBALT**.

RED Copper, *Ruby copper*, an ore of copper, of a cochineal red colour, inclining to a lead-grey. It consists, according

to Klaproth, of 91 parts copper and 9 of oxygen. See **COPPER**.

RED Hamatite, *Fer oligiste concretienne* of Haüy, an ore of iron, found in kidney-shaped and globular balls. The structure is fibrous, and divergently radiated, but arranged in concentric curves; the colour is a blueish-grey, intermixed with red. By friction, it acquires a high metallic lustre. It yields from 60 to 70 per cent. of pure iron. (See **IRON**.) An excellent ore of this kind is procured near Ulverstone, in the north of Lancashire, much valued, as producing an iron of a peculiarly ductile quality, suited for the purposes of the wire-drawers.

RED Lead. See **MINIUM** and **LEAD**.

RED Scaly Iron Ore, *Fer oligiste luisant* of Haüy. It consists of scaly particles slightly cohering; it has an unctuous feel, and stains the fingers. It passes into micaceous iron ore.

RED Schorl. See **Ores of TITANIUM**.

RED, or *Ruby Silver Ore*, *Argent antimonie sulphurée* of Haüy. Werner divides this into two sub-species, dark red silver ore, and light red silver ore, distinguished from each other by their colour, and the situations in which they occur. The dark red ore is commonly accompanied by galena, antimonial sulphuret of silver, quartz, calcareous spar, and pyrites. The colour is between cochineal red and lead-grey. It occurs massive, disseminated, and crystallized in equiangular six-sided prisms, frequently variously truncated. The form of the primitive crystal is an obtuse rhomboid, whose plain angles are $104^{\circ} 28'$ and $75^{\circ} 32'$; the inclination of the faces $109^{\circ} 28'$ and $70^{\circ} 32'$. The external lustre is splendid, and in some specimens metallic; internally it is shining, and sometimes semi-metallic and metallic. The fracture is uneven, and in the crystallized varieties imperfectly small conchoidal. See **Ores of SILVER**.

The massive varieties are opaque; the crystallized, semi-pellucid and pellucid. The colour of the streak is a cochineal red. This variety yields easily to the knife: before the blowpipe or charcoal it decrepitates, and melts with a slight effervescence, emitting a dense smoke, which colours the charcoal yellow, and leaves a globule of silver. The specific gravity is 5.563 to 5.608.

The light red silver ore is usually accompanied by native arsenic, white cobalt ore, orpiment, and sulphate of barytes. The colour passes from a carmine red to a medium between cochineal red and lead-grey. In most of its characters it agrees nearly with the dark red silver ore; but when fused, it yields an arsenical vapour. Hence some chemists have conjectured that this ore differs from the dark red ore, by the former containing antimony, and the latter arsenic. According to Klaproth, red silver ore contains nearly

	60 of silver,
	10.5 sulphur,
Combined with 29.4	{ 20.3 antimony,
of antimonial kimes,	{ 3.2 oxygen,
or - - - - -	{ 5.9 sulphur.

A variety of red silver ore, probably the light red ore of Werner, analysed by Proust, gave

74	sulphuret of silver,
25	sulphuret of arsenic.
.6	oxyd of iron.

Red silver ore may be distinguished from cinnabar and red copper ore, by its specific gravity, which is considerably less than the former, and greater than the latter; the specific gravity of red silver ore being 5.6 to 5.8.

of cinnabar	7 to 7.5.
red copper	3.9

RED Vitriol, a salt found at Neuhohl, in Hungary, in the form

form of transparent crystals of a pale rose-red colour, and more or less transparent. It was discovered by Klaproth to be a sulphate of cobalt. Its solution affords a pale blue precipitate, with carbonate of potash, which tinges borax a pure blue colour.

RED Charr, in *Ichthyology*. See CHARR.

RED Eye, *Erythrophthalmus*, the *cyprinus erythrophthalmus* of Linnaeus, called by some *rothauge*, or *rootang*, which, in the German language, signifies the same. It very much resembles the common river bream in shape, but that it is somewhat thicker. The fins are all red, and the whole body of the fish is stained with a very elegant red, but no part of it so much as the iris of the eyes. When the scales are off, the body is of a greenish hue; and it has a yellow spot under the tongue. It much resembles the river mullet in some particulars, but it is of a more beautiful colour, and its eyes are more red. Its largest size seems a foot in length. It is a well-tasted fish; and spawns in April, under cover of the roots of trees. Ray.

This fish is called *rudd* by some English authors; it is also called *rutilus latior*, *rubellio fluviatilis*, and *finseale*. It is very common in many of the rivers of Germany and England, and is in season all the year, except in spawning time, when the male is subject to a great number of white spots on its head, and is more rough than at any other season. Willughby. See *CYPRINUS Erythrophthalmus*.

RED-Breast, in *Ornithology*, a well-known bird, for the characters of which, see *MOTACILLA Rubecula*.

The song of this bird is remarkably fine and soft, and continues through the greatest part of the winter, spring, and summer. Many of the autumnal songsters seem to be the young cock red-breasts of that year. Pennant.

Thompson, in his *Seasons*, Winter, line 246, has admirably described the annual visits of this guest: and the ancient ballad of "The Babes in the Wood," recording the affection of this bird for mankind, is universally known.

RED Chatterer of Latham, *Red-bird* from Surinam of Edwards, and *Ampelis carnifex* of Gmelin, a bird of red colours, with an ocular band, and the wing and tail-feathers black at their tips. It is found in New Spain, Guiana, and Surinam.

RED Game, an English name of a bird, common in the mountainous parts of Yorkshire, and some other of our northern counties. See *GOR-cock*, *GROUSE*, and *TETRAO Lagopus*.

RED-Pole, or *Linnet*. See *FRINGILLA* and *LINNET*.

RED-Pole, *Yellow*, or *Red-headed Warbler*. See *MOTACILLA Petechia*.

RED-Shank, the name of a water bird, called by authors *gallinula erythropus*, and *callidrys*; the *scelopax calidris* of Linnaeus. It is about the size of the common plover. The back is of a greyish or brownish-green, usually spotted with black; its neck grey, and its throat variegated with black and white; the breast is white, with a few loose streaks of black; the wing-feathers are variegated with black, brown, and white; the bill is two fingers breadth long, slender, and shaped like the beak of the woodcock; reddish at the base, and blackish lower down; its legs are of a fine beautiful red, and the hinder toe is very short and small. It breeds in the fens and marshes; is found on most of our shores; conceals itself in winter in the gutters; and is generally found single, or at most in pairs. When disturbed it flies round its nest, making a noise like a lap-wing. It lays four eggs, of a whitish colour tinged with olive, and marked with irregular spots of black, chiefly on the thicker end. Ray and Pennant. See *SCOLOPAX*.

RED-Start, the English name of the *ruticilla*, or *motacilla*

phanicurus of Linnaeus, a very beautiful bird. The bill and legs of the male are black; the forehead white; the crown of the head, hind part of the neck, and the back, are of a deep blue-grey; the cheeks and throat black; the breast, rump, and sides, are red; the two middle feathers of the tail brown, the others red; the wings brown. In the female, the top of the head and back are of a deep ash colour; the rump and tail of a duller red than those of the male; the chin white; the lower side of the neck cinereous; and the breast of a paler red.

This bird appears among us only in the spring and summer, and is observed to come over nearly at the same time with the nightingale. It is so shy, that it will forsake its nest, formed with moss on the outside, and hair and feathers within, in hollow trees and the holes of buildings, if the eggs are only touched. It has a very fine soft note; and is remarkable for shaking its tail, and moving it horizontally, as a dog does when fawning. Pennant.

RED-Start, *Greater*. See *LANIUS Infansus*. See also *TURDUS Saxatilis*.

RED-Start, *Indian or Bengal*. See *LANIUS Emerica*.

RED-Start, *Small American*. See *MUSCICAPA Ruticilla*.

RED-Start, *Grey*. See *MOTACILLA Gibraltariensis* and *Erethacus*.

RED-Stone Poll. See *LINNET*.

RED-Tail. See *MOTACILLA Erethacus* and *Guianensis*.

RED Tanager, and *Summer Red-bird*. See *TANAGRA*.

RED-Wing, the name of a bird of the *turdus*, or thrush kind, called also in some places the *wind thrush*, or *swine pipe*; and by Linnaeus and others the *turdus iliacus*, or *ilias*.

It is a little smaller than the common thrush, and is less spotted. Its back, neck, and head, are of the same colour with those of the common thrush; but its sides under the wings, and the feathers which line the wings, are of an orange colour, or dusky red; its belly and breast are whitish, and its throat yellowish, with brown spots: the wings are of a sort of chestnut colour, a little variegated. It feeds on insects, as worms, and the like; and is a bird of passage, coming to us in large flocks about the same time with the fieldfare, and leaving us also when that bird does. When the red-wing appears on the coast in autumn, it is certain the woodcocks are near. It is not well known where they breed, though some have guessed it to be in the mountains of Germany and Bohemia. They have a bitterish taste, and are less valued than the fieldfare. With us they have a disagreeable piping note; but in Sweden, during the spring, they sing very finely, perching on the top of some tree among the forests of maples. They nest in hedges, and lay six bluish-green eggs spotted with black. Ray and Pennant.

RED Water, a disease in sheep. It has been supposed by farmers to be caused by taking too much watery food, such as turnips, clover, rape, eddish, &c., but it is not peculiar to sheep feeding on turnips or rape, as has been believed by some. Its removal has been attempted by the use of common salt, a tea-spoonful of elixir of vitriol, and the frequent driving the animal about; and it is asserted, that the disease may be wholly prevented by having recourse to the use of dry food, in the night time, while the sheep are feeding upon these juicy kinds of food. See *SHEEP*.

In Sussex the sheep are sometimes affected with this complaint on their being first turned into turnips, which is supposed to be caused by their eating too large a portion of them in wet seasons. The disease is also believed to originate in the sheep being let out of the fold, when the ground

is covered with hoar frost; and often from feeding in the oat-crishes about the beginning of the autumn, when the young oats are strong. It is thought here to be readily obviated by allowing a small quantity of hay so as to counteract the great wateriness of the turnip; the quantity of half a pound or even less in the course of the day is believed to be quite enough for each sheep in this intention. It is likewise suspected, that clover, stubble, and folded land, are productive of it in wet weather or moist seasons.

RED Weed, in *Botany*, a name given to a plant common in the Bermudas, and some other places; and called by our first travellers to that part of the world, the *Summer Island red weed*. Its berry is of a fine red colour, and affords a tincture little inferior to that of cochineal, and possessing all its virtues in medicine: the only misfortune of this, and some other very fine vegetable colours, is, that they fade soon. The juice of the fruit of the opuntia, or prickly pear, is as fine a dye as can be procured from the cochineal; but it will not stand; the insect feeding on this, however, we find affords a colour of the same nature that will stand. The fruit of the red weed is in the same manner liable to be eaten by insects as that of the prickly pear; and it is worthy a trial, whether the colour obtained at second hand from those insects, will not stand as well as the cochineal does, and whether the insects may not be propagated in a sufficient abundance to serve the markets in the same manner. Phil. Transf. N^o 40.

RED Weed is also a provincial term, signifying the round smooth-headed poppy, a pernicious weed in corn-fields. See *WEEDS*.

RED Worm, in *Natural History*, the name of an insect very destructive to young corn crops. The following description of this worm has been given by Mr. W. Baker: after observing, that he has often heard of the havoc which red worms make in young wheat, barley, and oats; and in some few writers upon husbandry has read of them, but never saw them till May 1764; when, to his great mortification, in a few days they destroyed almost totally nine acres of his wheat, for he did not reap above half a barrel *per acre*; and that the ingenious M. de Chateauxvieux speaks of an insect, which is certainly of the same kind, if it be not the very insect which he has now under consideration; and in noticing the loss sustained in wheat crops, says, they found in it many little white worms, which afterwards became of a chestnut colour. They posit themselves between the blades, and eat the stems. They are usually found between the first joint and the roots; every stalk which they attacked grew no more, but became yellow and withered. And the same misfortune happened to them in the year 1732. The insects appeared about the middle of May, and made such havoc, that the crops were almost destroyed; Stillingfleet, also, in the second edition of his Miscellaneous Tracts, speaks of an insect, which is probably the same as in Suffolk and in some parts of Norfolk, where the farmers find it their interest to encourage the breed of rooks, as the only means to free their grounds from the grub, from which the tree or blind-beetle comes, and which in its grub state destroys the roots of corn and grass to such a degree, that he has seen a piece of pasture land where you might turn up the turf with your feet: he adds, that Mr. Matthews, a very observing and excellent farmer of War-grove, in Berkshire, told him, that the rooks one year, whilst his men were hoeing a turnip field, sat down in a part of it, where they were not at work, and that the crop was very fine in that part, whereas in the other part there were no turnips that year; though M. de Chateauxvieux describes this worm as being first white, and afterwards be-

coming of a chestnut colour, he has carefully sought them at different periods during the past year, but always found them of the same chestnut colour, never varying in any particular except that of size, which he finds to be the case at all seasons in which he has seen them; and he observes, that the insect spoken of by Stillingfleet as a grub, which, he says, destroys corn and grass, induces him to believe that it is the same insect (though the report which he relates from Mr. Matthews seems to contradict it), because he has observed that the red or chestnut worm never appears voluntarily upon the surface; but when the earth is turned up, either with plough or spade, the rooks or crows are very bold in their approach to pick them up, a circumstance which, he owns, has in some degree abated his enmity to these birds; he therefore never destroys or frightens them off his land whilst he is ploughing it; but when he sows, when the corn rises, and when it is ripe, he destroys or banishes them as well as he can, because the mischief which they do at these times is intolerable; he has also observed his lucern to decay in its tops soon after it has been up; and upon examining the roots he has found the red worm which had eat them off; and that, in fact, this insect seems to be every where in Ireland called the red worm, but by some of the English writers, who have spoken of an insect which destroys the corn in the manner already mentioned, which he thinks undoubtedly the same, it is called a grub, by others the large maggot, and the rook worm, because the rooks eat it.

These worms are about half an inch long, and about one-tenth of an inch in diameter; they are jointed in their skins, and are of a very firm texture: they have many short legs, two small black specks, which appear to be their eyes; and two small points springing from their heads, with which, he believes, they eat the corn, and which in that work, he apprehends, act like forceps: and all that he has seen of this species are of a bright chestnut colour. For this reason, he should conceive it would be more descriptive to call them the chestnut-worms. When they are exposed to the air, by turning up earth which is infested with them, they will very soon cover themselves again in the soil, which they are very capable of doing by the strength which their make gives them, although they appear to be a sluggish insect, and have not the advantage of a sliminess upon their skins, which the common large creeping worm has, which enables that inoffensive worm to penetrate the earth, and get under timber and stones with ease. The red worm, immediately endeavouring to cover itself from the air, is certainly, he thinks, from natural instinct, as it will soon die when exposed to the air, as will appear by the experiment, N^o 10, mentioned below.

It is further stated, that these worms destroy wheat, barley, oats, and lucern, while in an infant state, in the months of March, April, and May. Late sown barley and oats they will destroy as late as June. He has not yet experienced that they destroy any other crops. The mischief done by them is in dry weather. Rain sufficient to penetrate the ground makes them desist from destroying the corn; and he supposes every thing else which they at any time injure. They eat wheat off just above the crown of the roots; barley and oats in the same place, and also higher up, upon any part of the stem which is below the surface of the earth. And these worms seem to abound more in ground which is lightly tilled, than in such as hath been well tilled; but in lay ground they seem to be more numerous than any where else: and the fields upon his farm in which he has found them, are wetter than other fields where they are not; whether that circumstance contributes to their increase, he cannot say; but the following

lowing experiments prove that they will live longer in water than they can when exposed to the open air.

Experiments.

N^o 1. He put ten red worms into a wine glass with common salt in it. They were all dead in four hours.

N^o 2. Into a glass with brine in it he put ten red worms. They were all dead in six hours.

N^o 3. Into a glass with lime in it, which had been slaked for a long time, and exposed to the weather, he put the like number. They were all dead in forty-four hours.

N^o 4. Into a glass with the above lime, and some water in it, he put the like number. They were dead in twenty hours.

N^o 5. Into a glass with lime newly slaked, and when cold, he put the like number. They were dead in fourteen hours.

N^o 6. Into lime water, made with cold water, he put the like number. They were dead in ten hours.

N^o 7. Into a glass with foot in it, he put the like number. They were dead in four hours.

N^o 8. Into foot and water he put the like number. They were dead in four hours.

N^o 9. Into pure water he put the like number. They were dead in fifty-two hours.

N^o 10. Into a glass, without any thing in it, he put the like number. They were dead in thirty-two hours.

It is stated that by these experiments it is seen that all the articles used will kill this insect in a short time, particularly the salt and foot. He thought it necessary to consider different articles, the better to suit different parts of the kingdom.

Where lime can be conveniently had, and that it is used as manure, he is apt to believe, from the experiments, that no injury can be sustained from these worms; but he is afraid a small quantity will not effectually destroy them; besides, he should fear, if it were not put on before the sowing of the corn, that it might singe the blades of the corn; for, from these experiments, it appears that lime newly slaked is more suddenly destructive to them than old lime, and therefore it is to be preferred.

Where lime is used for no other purpose than to destroy this worm, he should conceive, that about eight barrels, regularly sown by hand on an acre of ground, might be sufficient: it must be first slaked and cold before a man can possibly cast it upon the ground with his hand, lime being a very strong caustic; and even when it is cold the man should have a thick glove upon his hand.

Where salt may be used to destroy this worm, it must always be sown upon the ground before the intended crop; for although corn will vegetate, and receive benefit from salt as a manure, when it is used antecedent to the sowing of the corn, yet if it be added after the corn is growing it will certainly destroy it: therefore it should never be used for this purpose, but before the corn is sown, or at least before it vegetates.

He conceives that where salt is used for this purpose only, about four hundred and a half to an acre will answer the purpose, which is a little more than one ounce to every square yard.

It is seen by the experiments, that foot kills this worm as soon as salt; and as in most places it is to be had at a much less price than salt, he thinks there can be no doubt about preferring it; besides which, it may be safely used after the corn is up.

He had some small parcels of barley under experiments, which these worms began to destroy; and in order to con-

vey the foot as soon as possible to the roots of the plants, he mixed a little of it in water, and poured it on the plants with a garden watering-pot: the consequence was that he did not lose one plant afterwards.

It will hardly be imagined that he means that the same method is to be pursued upon a whole farm: no; the method he would recommend to the practice of the farmer is this; to spread, or cast by hand, as he sows his corn, about six or eight barrels of foot on an acre, and let him be careful to choose a calm day for the work, otherwise the wind will carry away a great part of it: and as what remains cannot be regularly disposed, let him be careful to do it early enough in the spring, that the rain may wash in the foot and convey it to the roots of the plants before the worm begins the mischief; if he does this, he is persuaded his crop will be preserved.

It is found by the experiments, that these worms will live longer in water, by twenty hours, than when exposed to the open air; but at length, that is in fifty-two hours, they died in the water; perhaps this might be from the effect of drowning; but if so, he might have expected they would have been totally destroyed in his two fields in the winter of 1763 and 1764, by the immoderate rains which fell at that season for a long continuance, which often flooded the lands. But they survived that winter, as appeared by the great loss he afterwards sustained by their destroying his wheat; and therefore, whether water be an enemy to them or not, it seems not easy to determine: but if those which died in the glass of water were really drowned, he thinks we may conclude that water is necessary to their existence in the earth, and probably aids them in getting their food from it: and what seems to confirm this notion is, that when the land is wet, they do not touch the corn, but as soon as ever the land is dry, they begin their mischief. However, this speculation he must submit to the consideration of persons more capable of discussing it than he is.

It is seen by experiment N^o 10, that they cannot live in the open air, which seems to prove, that, where they abound in land, the oftener it is ploughed, particularly in the summer, when they cannot penetrate the ground so easily as when it is moist, they must be, by such ploughing, greatly diminished: besides which, the frequent ploughing gives the crows more opportunities of picking them up, in which, as he has before said, they are very watchful.

Frequent ploughing has been recommended by some writers as the only means of destroying this worm; and they have recommended the ploughs being stuck with nails, urging, that by those nails the worms are cut to pieces; others have recommended walnut leaves being soaked in water, to sprinkle the land, and steeping feed corn in various liquors, as infallible remedies; but such methods as these are founded upon mistaken principles; they only mislead the farmer, and must disappoint him.

Worlidge recommends a strong ley made of fixed salts, but that would be impracticable. Mortimer recommends sea-water, which he believes would answer very well. He says, he used foot once with success, but that it did not succeed with him afterwards. Mr. Baker is persuaded he did not use the foot early enough to have it washed into the ground by rain, or perhaps he used too small a quantity. He concludes by observing, that he would not be thought to arrogate any merit to himself, on account of what he has here offered on this subject, since it appears that other persons have used the articles which he has recommended, against this common enemy; but many persons have been disappointed in their expectations from these remedies,

remedies, which must have arisen, he thinks, from their either having used too small a quantity, or not having observed the necessary precautions; if those which he has recommended shall be put in practice and found to answer, he shall think himself amply rewarded.

This worm undoubtedly does great injury to grain crops in many cases, in particular soils and sorts of land; but a great number of additional facts and experiments are waiting to fully prove its nature, and the ways in which its destructive effects on such crops are produced, as well as the best, most ready, convenient, and effectual ways in which it can be destroyed. See *WIRE-WORM*.

RED Deer, fish, flax, storax, tartar. See the substantives.

RED Ink. See *INK* and *PRINTING*.

RED Notes, in old *Music*, before the invention of printing, were used for diminution. In the MS. at Paris of the Latin and French poems of Guillaume Machau set to music, chiefly motets for a single voice, some are written in black and red notes, with this instruction to the fingers; "nigræ sunt perfectæ, et rubræ imperfectæ;" an admonition worth remembering by those who wish to decypher music of the fourteenth and fifteenth centuries, in which red notes frequently occur. It was an easy expedient of diminution till the invention of the press, when the use of different coloured inks on the same page occasioned the trouble and expence of double printing. See *MACHAU*.

In the Papyrian collection at Cambridge, there are examples of the use of red notes for diminution in fragments of music by Joseph Gwineth and Robert Davie, who flourished in the time of Edward IV. Morley has given some examples of the use of red notes in his annotations.

RED Bank, in *Geography*, a fort of the United States, on the S.E. side of Delaware river, in the town of Woodbury, Gloucester county, New Jersey; seven miles S. of Philadelphia.

RED Bay, a bay on the N. coast of Spitzbergen. N. lat. 79° 44'. E. long. 10° 42'.—Also, a bay on the S.E. coast of Labrador. N. lat. 51° 50'. W. long. 56° 10'.—Also, a bay on the N. part of Buffalo's bay, on the S. coast of Massachusetts, in America.

RED Crab Island, a small island in the East Indian sea, near the coast of Arracan. N. lat. 21° 30'. E. long. 91° 50'.

RED Deer Lake, a lake of North America. N. lat. 55° 10'. W. long. 112°.

RED Flaggy Bay, a bay on the N. coast of the island of St. Christopher, E. of Ragged Point.

RED Haven, a bay of Scotland, on the N. coast of the county of Banff; three miles E. of Cullen. N. lat. 57° 39'. W. long. 2° 38'.

RED Head, a cape of Scotland, on the E. coast of the county of Angus; six miles S. of Montrose. N. lat. 56° 33'. W. long. 2° 26'.—Also, the N. point of the island of Eda. N. lat. 59° 6'. W. long. 2° 40'.

RED Hills, rocks in the German sea, near the coast of Northumberland. N. lat. 55° 26'. W. long. 1° 17'.

RED Hook, a town of America, in the township of Rhinebeck, and Dutchess county, New York, on the E. bank of Hudson's river; 21 miles S. of Hudson.

RED Horse, Vale of, a district of England, in the county of Warwick, which owes its name to a horse cut in a hill, the soil of which is reddish.

RED Island, an island near the E. coast of Labrador. N. lat. 43° 55'. W. long. 55° 50'.—Also, an island near the W. coast of Newfoundland. N. lat. 48° 35'. W. long. 59° 10'.

RED Lake, a comparatively small lake of North Ame-

rica, at the head of a branch of the Bourbon river, sometimes called "Red river;" its form is nearly round, and its extent is about 60 miles in circumference. It has on one side an island, close by which a river enters. It lies almost S.E. both from lake Winnepeck, and from the lake of the Woods. N. lat. 51° 5'. W. long. 94° 10'.—Also, a lake of North America, in N. lat. 47° 40'. W. long. 95° 15'.

RED Lick, a salt spring of the state of Kentucky; 32 miles E. of Stamford.

RED Point, a cape on the E. coast of New Holland. N. lat. 34° 29'. W. long. 208° 45'.

RED River, a river of Louisiana, which rises in about N. lat. 35°, and W. long. 96°, and runs into the Mississippi, N. lat. 37° 15'. W. long. 91° 48'.—Also, a river of Upper Canada, which runs into lake Superior. N. lat. 47° 51'. W. long. 85° 48'.—Also, a river of Tennessee, which runs into Cumberland river, about two miles N.W. of Clarksville. N. lat. 36° 18'. W. long. 87° 46'.—Also, a river of Kentucky, which runs into Kentucky river, about nine miles above Boonborough, N. lat. 37° 45'. W. long. 84° 18'. It is 60 yards wide at the mouth.—Also, a river of North America, which rises from Red lake, in N. lat. 47° 40', and runs into Winnipeg lake.—Also, a river of Canada, which runs into the Utwas; 60 miles W. of Montreal. See also *NATCHITOCHES*.

RED Sea, called by the ancients the "Arabian gulph," forms the grand natural division between Asia and Africa, and extends about 21° or 1470 British miles from the straits of Babelmandeb to Suez; it terminates in two branches, the western being extensive, and the eastern ascending a little beyond the parallel of mount Sinai.

This sea is called, in the Old Testament, the sea of Suph or Zuph, the sea of weeds, on account of the great quantity of algæ and fuci, and perhaps the madrepores and coralline substances, anciently supposed to be of vegetable origin, found at its bottom, and near the shores. In scripture language it is also denominated "the tongue of the Egyptian sea;" in the Greek and Latin geography, it was called the gulph of Heroopolis; and by the Arabian geographers, the western arm of the sea of Kolzum, (al Kolzum, with the article,) which seems to have some affinity with "Clysma," another name by which this gulph was formerly known; Kolzum in Arabic, and Clysma in Greek, signifying destruction, in reference, as it is supposed, to the destruction of Pharaoh's host. Don John de Castro, viceroy of the Indies for the king of Portugal, conjectures that it was called the Red sea from the great quantity of coral that is found in it. Pliny says that it obtained this name, in Greek "Erythrea," from a king called Erythros, who reigned in Arabia, and whose tomb was seen in the island Tyrene or Agyris. Several learned men believe, that this king Erythros is no other than Esau, or Edom; Edom, in Hebrew, signifying red or ruddy, as Erythros does in Greek. But Calmet is of opinion, that Edom never dwelt, either on the shore of the Red sea, or the Persian gulph, which has been sometimes also called the Red sea. His habitation was east of the land of Canaan, towards Bozra; and he inclines to believe, that the name of the Red sea was not given to this gulph till after the Idumeans, descended from Edom, had spread themselves from east to west as far as the Red sea. At that time it might receive the name of the sea of Edom, which the Greeks rendered by the Red sea, or "thalassa erythrea."

The famous miracle of the passage of the Red sea by 600,000 Israelites, besides old men, women, and children, recorded in the sacred writings, is well known. Those who have been desirous of explaining this passage, with-

out admitting the miraculous part of the history, have had recourse to a variety of conjectures; both as to the place and the manner in which this passage was effected. As to the place of the passage, there has been a difference of opinion even among those who have not hesitated to acknowledge that it was miraculous. Till of late years it has been generally believed, that the passage of the Israelites was at Baideah, or Bedea, which, according to Niebuhr, is about six German miles from Suez, and where the sea, says Bruce, is something less than four leagues broad, by 50 feet deep. In support of this hypothesis, Dr. Shaw has traced the march of the Israelites to their third encampment before Pihahhiroth. Whilst they were removing from the edge of the wilderness of Etham towards this station, they had left the open country and were marching through a narrow pass, betwixt the mountains of Gewoubee and Attackah. In these circumstances the Egyptians might well imagine, that they could have no possible way of escape, as the mountains of Gewoubee would obstruct their progress towards the south, and those of Attackah would impede their advancing towards the land of the Philistines: the Red sea lay before them to the east; whilst Pharaoh closed up the valley behind them, with his chariots and horsemen. This valley terminates at the sea, in a small bay, made by the eastern extremities of the mountains above-mentioned; and is called "Tiah Beni Israel," *i. e.* the road of the Israelites, from a tradition still existing among the Arabs of their having passed through it; and it is also called "Baideah," from the *new* and unheard-of miracle that was wrought near it, by dividing the Red sea, and destroying in it, Pharaoh, his chariots and his horsemen. The encampment of the Israelites, according to Dr. Shaw, was at this bay, before Pihahhiroth, betwixt Migdol and the sea, over-against Baal-tzephon, Exod. xiv. 2. Baal-tzephon, as this learned geographer suggests, might have relation to the northern situation of the place itself, or to some watch-tower, or idol-temple that was erected upon it; or it may be taken for the extremity of the mountains of Suez, or Attackah, the most conspicuous of these deserts, as it overlooks a great part of the Lower Thebais, as well as the wilderness that reaches towards, or rather which makes part of, the land of the Philistines. Migdol might lie to the south, as Baal-tzephon did to the north of Pihahhiroth. The marches of the Israelites, from the edge of the wilderness, being towards the sea, *i. e.* towards the S.E., their encampment betwixt Migdol and the sea, or before Migdol, could not well have any other situation. Pihahhiroth, or the mouth of Hhiroth, or a narrow gullet or defile, may denote the mouth, or the most advanced part of this valley towards the E., or towards the Red sea. But as the Israelites were delivered at this place from their captivity and fear of the Egyptians (Exod. xiv. 13.) we may suppose that Hhiroth denotes the place where they gained their liberty, *horar* and *hhiroth* being words of the like import in the Chaldee. It may be further urged in favour of this explication, and also of the tradition still preserved, of the Israelites having passed through this valley, that the eastern extremity of the mountain, supposed to be Baal-tzephon, is called, even to this day, by the inhabitants of these deserts, "Jibbel Attakah," or the mountain of deliverance; which appellation, together with those of Baideah and Tiah Beni Israel, could never have been given or imposed upon these inhabitants at first, or preserved by them afterwards, without some faithful tradition, that such places had been once the actual scene of these remarkable transactions. The sea likewise of Kolzum, *i. e.* destruction, as the correspondent part of the Red sea is called in the Arabian geography, is a further confirmation of this tradition. Moreover, the

Ichthyophagi, who lived in this very neighbourhood, are reported by Diodorus Siculus (l. iii.) to have preserved the like traditionary account from their forefathers, of this miraculous division of the Red sea. There are likewise other circumstances that tend to prove, that the Israelites took their departure from this valley, in their passage through the Red sea; for an account of which we refer to Shaw's Travels, ch. v.

This hypothesis, however, says Geddes, (Crit. Remarks on Exod. xiv.) has been fairly given up by our best modern critics; and the "Sinus Heroopolitanus," or gulph of Suez, pitched upon as the scene of action. The idea was first suggested by Le Clerc, and since adopted and defended by Michaelis, Niebuhr, and almost all the German commentators. But Mr. Bryant still contends for Bedea (Baideah), and calls the arguments of Niebuhr "prejudice and misconception." Dr. Geddes, whose sentiments concerning Moses and his whole history are singular, denies that there was any thing miraculous in the event; and strenuously maintains, that Suez or its vicinity was the place of passage; for here, he says, at this day, are shallows fordable at low water, and which might, in former times, have been frequently dry. We all know what changes happen in the bed of seas as well as that of rivers, especially where that bed is sand, which is the case with that of the gulph of Suez. The occurrence is thus described by Dr. Geddes. When Moses saw that the Egyptians had found out that the Israelites meant not to return, and were about to pursue him with a force which he could not resist, he wisely took the only course that was most likely to afford him an escape. Acquainted, as he must have been, during his long stay in Midian, with the nature of the Red sea, and its ebbs and flows, he deemed it better to take his chance of passing over some shallow which he knew to be fordable at low water, than to expose himself to be overtaken in a desert, where no stratagem could save him. If he got the start of the Egyptians but for a single day, he would have time to watch the tide, and begin his march as soon as the passage was fordable; and in the space of a few hours might be safe on the other side. The width of the sea at Suez is at present, according to Niebuhr's measurement, 757 double paces, or 3450 feet. It is common for the Arabs to pass on foot over this passage, although not always without danger, as the sea sometimes flows back unexpectedly. At Suez, according to Niebuhr, it is low water, at the full of the moon, at half past six; but as the passage of the Israelites must have happened some days after the full of the moon, the ebb and flow must have been considerably later, and the former must have occurred in the night-time, during which the Israelites are said to have passed. Michaelis was of opinion, that, as a strong wind is said to have accompanied this event, it might have caused a double ebb, as it sometimes does on the coast of Holland and North Germany; but Niebuhr thinks that no such thing is likely to happen in the Red sea. Be this as it will, the wind might certainly have prolonged the ebb; and, if it happened at the time of the passage, might well be considered as a providential interference, and readily construed into a miracle. Josephus, in recording this transaction, puts a formal speech into the mouth of Moses to his terrified and discontented people, and a prayer to God before he strikes the sea with his rod; yet he tells us that all this he has related as he found it in the sacred books. But he seems not sure, whether to consider it as a miracle or a natural effect. "Let no one," says he, "wonder at this account of a way of safety being opened to those old-world innocent folks, even through the sea, whether by the will of God or naturally; since, of later days, the Pamphylian sea opened a way

way for Alexander's army, when God through him had decreed to overturn the Persian empire." (Antiq. l. ii. c. 16. n. 5.) For this he appeals to all Alexander's historians; and, indeed, both Appian and Arrian, who relate the event, seemed to have considered it as a sort of divine interposition; but honest Strabo tells us, that Alexander only took the advantage of low water; and, trusting to his good fortune, passed through the strait with his army; but not on dry land; for the water came up to the navel. (Strab. l. xiv.) The same was the case with Scipio's soldiers, who surprised New Carthage by taking the advantage of an ebb; although they waded sometimes up to the knee, at other times up to the navel, in water. (Liv. l. xxvi.) Here, says Geddes, the same two natural causes, the tide and a strong wind, concurred to make a passage through the water, as concurred at the passage of the Red sea; and in both cases they were converted into a miracle. Josephus concludes his narrative with these words. "Of such things, let every one think as he pleases;" and the author now cited adopts his language. It has been said, and thus the priests of Memphis explained the history (see Euseb. Præp. l. iv. c. 17.), that Moses taking advantage of the time of the ebb, led the Hebrews over in safety; but the Egyptians, not knowing the nature of the sea, and easily entering it just before the return of the tide, were all swallowed up and drowned.

In opposition to all conjectures for explaining this history, without having recourse to miracle, we shall content ourselves with appealing to the history itself, Exod. xiv. 16, 17, &c. from which it appears that the Hebrews traversed the sea from shore to shore, on a large space of dry ground, which was left by the retiring waters; and that they were driven back to overwhelm the pursuing host of Pharaoh. See also Isaiah, lxiii. 11, &c. Habbakuk, iii. 15. Wisdom of Sol. xix. 7, 8. x. 17, 18.

It is thought, says Calmet, after Eusebius, that the place where the Hebrews passed the Red sea, is two or three leagues below its northern point, at the place called Kolfum, or Clyfma. Niebuhr informs us that, every where on the coast of Arabia, we meet with indications, that the waters are withdrawn; *e. gr.* Mufa, which ancient authors mention as a port of Arabia, is now at many leagues distance from the sea; near Loheia, and Gidda, we see great hills filled with the same kind of shells and corals, as are now found living in the sea; near Suez, are petrifications of all these things. From these and similar circumstances he infers, that some thousand years ago this Arabian gulf was much larger, and extended much farther north, especially that arm of it near Suez, for the shore of this extremity of the gulf is very low. The breadth of the arm of the sea at Suez, he adds, is about 3450 or 3500 feet (in its present state). Although it would much shorten the distance of their way, no caravan now crosses this arm, nor could the Israelites have crossed it, without a miracle. The attempt must have been much more difficult to the Israelites, some thousand years ago, the gulf being then probably larger, deeper, and longer toward the north, at the lowest time of the tide. Niebuhr crossed, when returning from mount Sinai, that arm of the sea, over to Kolfoum, upon his camel; and the Arabs, who accompanied him, were only immersed to their thighs in water. The banks of the Red sea are pure sand from Suez to Girondel; but lower to the south are banks of coral. If the Israelites had crossed the sea upon such banks, they must have been greatly incommoded by them.

The Red sea, notwithstanding the difficulty and danger, and also the tediousness of its navigation, was, for many ages before the discovery of the passage by the Cape of Good

Hope, the channel of communication between Egypt and other countries, bordering on the Mediterranean, and India. Accordingly, Dr. Robertson observes, in his "Historical Disquisition concerning Ancient India," that navigation made its first efforts in the Mediterranean and the Arabian gulf, and that in them the first active operations of commerce were carried on. Nor are the accounts of the earliest historians in this respect at all improbable, if we consider the position and form of these two great inland seas. They lay open the continents of Europe, Asia, and Africa, and spreading to a great extent along the coasts of the most fertile and most early civilized countries in each, seem to have been destined by nature to facilitate their communication with one another. We find, accordingly, that the first voyages of the Egyptians and Phœnicians, the most ancient navigators mentioned in history, were made in the Mediterranean, and, moreover, by acquiring early possession of ports on the Arabian gulf, they extended the sphere of their commerce, and are represented as the first people of the west who opened a communication by sea with India. Sesostris, in the course of his reign (if we may give credit to some historians), was able to fit out a fleet of 400 ships in the Arabian gulf, which conquered all the countries stretching along the Erythrean sea to India. The Phœnicians, who, by their situation on the Mediterranean, and the imperfect state of navigation, could not attempt to open a direct communication with India by sea, were prompted by the enterprising spirit of commerce to wrest from the Idumeans some commodious harbours towards the bottom of the Arabian gulf. From these they held a regular intercourse with India on the one hand, and with the eastern and southern coasts of Africa on the other. The distance, however, from the Arabian gulf to Tyre was so considerable, that it became necessary for them to take possession of Rhinocolura, the nearest port in the Mediterranean to the Arabian gulf. Thither all the commodities brought from India were conveyed over land by a route much shorter, and more practicable, than that by which the productions of the East were carried at a subsequent period from the opposite shore of the Arabian gulf to the Nile. At Rhinocolura they were reshipped and transported by an easy navigation to Tyre, and distributed through the world. For an account of the trade which the Jews carried on by the Red sea, we refer to the articles OPHIR and TYRE. For the manner in which the Egyptians carried on their trade with India by means of this gulf, see ALEXANDRIA and BERENICE.

All the commercial transactions of the ancients with the East were confined to the ports on the Malabar coast, or at the farthest extended to the island of Ceylon. To these staples, the natives of all the different regions in the eastern parts of Asia brought the commodities which were the growth of their several countries, or the product of their ingenuity, in their own vessels, and with them the ships from Tyre and from Egypt completed their investments. While the operations of their Indian trade were carried on within a sphere so circumscribed, the conveyance of a cargo by the Arabian gulf, notwithstanding the expence of land-carriage, either from Elath to Rhinocolura, or across the desert to the Nile, was so safe and commodious, that the merchants of Tyre and Alexandria had little reason to be solicitous for the discovery of any other. During the period in which this mode of carrying on commerce subsisted, the price of goods imported from India into Europe was very much enhanced by the various operations to which the conveyance of them was subject. In Ceylon, or the ports on the Malabar coast to which they were brought from the various countries of Asia by the natives, they were put

put on board the ships which arrived from the Arabian gulf. At Berenice they were landed, and carried by camels 258 miles to the banks of the Nile. There they were again embarked, and conveyed down the river to Alexandria, whence they were dispatched to different markets. But, after the passage to India by the Cape of Good Hope was discovered by Vasco de Gama, at the close of the fifteenth century, its various commodities were purchased at first hand in the countries of which they were the growth or manufacture; and as the carriage of mercantile goods by water is much less expensive than by any other mode of conveyance, the Portuguese, as soon as they could import the productions of India in sufficient quantities to supply the demands of Europe, were able to afford them at such a reduced price, that the competition of the Genoese and the Venetians, who had been actively engaged in this commerce, ceased almost entirely; and the full stream of commerce took its natural direction towards the cheapest market. The consequence was, that early in the sixteenth century, the subjects of the Portuguese monarchs became possessed of a monopoly of the trade with India, founded upon the only equitable title, that of furnishing its productions in greater abundance, and at a more moderate price. From the era of the discovery now mentioned, the Arabian gulf or Red sea lost its importance as a channel of communication between the western and eastern parts of the globe; and from this time both its navigation, and the commerce connected with it, have been partial and restricted. An account of its principal ports will be found under their respective articles.

REDA, a town of Turkish Armenia, in the government of Erzerum; 36 miles N. of Ispira.

REDANS, or REDANT See REDENS.

REDARIDES, in *Geography*, a town of France, in the department of the Mouths of the Rhone; 16 miles S.S.E. of Orangi.

RED-BOOK of the *Exchequer* (*liber rubeus scaccarii*) is an ancient record, in which are registered the names of those that held lands *per baroniam* in king Henry II's time. It is a manuscript volume of several miscellaneous treatises, in the keeping of the king's remembrancer, in his office in the exchequer; and hath some things (as the number of the hides of land in many of our counties, &c.) relating to the times before the Conquest. There is likewise an exact collection of the escheques under king Henry I., Richard II., and king John; and the ceremonies used at the coronation of queen Eleanor, wife to king Henry III. &c.

REDDAT. *Precipe quod Reddat.* See PRECIPE.

REDDENDIS CHARTIS. See CHARTIS.

REDDENDUM, in *Law*, a clause in a lease, &c. by which a rent is reserved to the lessor; which anciently consisted of corn, flesh, fish, and other victuals. 2 Rep. 71.

REDDIDIT SE, is where a man procures bail for himself to an action in any court at law; if the party bailed at any time before the return of the second *seire facias* against the bail, renders himself in discharge of his bail, they are thereby discharged. 2 Lill. Abr. 430. See BAIL.

REDDITARIUM, an ancient law term for a tarrier, roll, or rental, in which the rents and services of a manor are set down.

REDDITION, REDDITIO, a surrendering or restoring. In *Law*, it also denotes a judicial acknowledgment that a thing in question belongs to the demandant, and not to the persons so surrendering.

REDDITUS ASSISUS, a set or standing rent. See ASSISUS.

REDDLE, *Red Ochre*, or *Red Chalk*, in *Mineralogy*, the red oxyd of iron intermixed with earthy matter. It is Vol. XXIX.

used for crayons, either in its natural state, or pounded and washed, and afterwards mixed with gum, and cast into moulds. The colour of reddle varies from a blood-red to a brown-red; its fracture is earthy; it is soft, friable, and stains the fingers. See *Ores of Iron*.

This is the common English name for the substance called in Latin *rubrica*, and used in painting, and for marking sheep, &c. There are two kinds of it, a harder and a softer.

The first, or harder kind, is but little in use, except among the turners in wood, as it does not mark so easily, requiring to be first wetted, and then pressed hard upon the substance to be marked. This is dug in Lincolnshire, Hampshire, and Sussex; and is a hard and dry earth, of a somewhat pale red, like the common pale red bricks, and is of a very regular and close texture, and always composed of a number of thin laminæ, lying closely and evenly on one another. It is of a rough uneven surface, adheres firmly to the tongue, is not easily broken between the fingers, and stains the hands a little; it is of a very atringent taste, and melts pretty readily in the mouth. It is very readily diffusible in water, moultering to powder, soon after being thrown into it; and makes no effervescence with acids.

The second, or softer kind, is very common, and put to a number of different uses. It makes simply a very good pale red for the painters, and is very serviceable to them in their mixed colours. It is in constant use in many parts of the kingdom for the marking of sheep; and when washed and separated from its sandy particles, is, by some of our modern druggists, sold under the name of bole armenic.

It is found in many parts of the world: the best in England is that from several parts of Derbyshire, from whence the colour-shops and druggists of London are supplied; many of the latter thinking this a shorter method than the common one of our bole armenic makers, of preparing it from a mixture of tobacco-pipe clay, and the red ochre called Spanish brown.

This soft, or common reddle, is a loose ponderous earth, of a lax texture, and very friable; and of a pale, but tolerably bright red, of a somewhat smooth and glossy surface, soft to the touch, adhering firmly to the tongue, easily broken between the fingers, and staining the hands. It is of a rough austere taste, very readily breaks, and falls to powder in water, and makes no effervescence with aqua fortis. Hill.

Some call reddle, *lapis hæmatites*; but the real hæmatites is another thing.

REDEEMABLES, in *Law*, are lands, funds, &c. sold with a reservation of the equity of redemption.

Crown lands are redeemable for ever; others only for a certain time.

RE-DELIVERY, an yielding or delivery back of a thing: if a person has committed a robbery, and stolen the goods of another, he cannot afterwards purge the offence by any re-delivery. Co. Litt. 69. H. P. C. 72.

RE-DEMISE. See DEMISE.

REDEMPTION, REDEMPTIO, a faculty or right of re-entering upon lands, &c. that have been sold, and assigned; upon reimbursing the purchase-money, with legal costs.

Bargains in which the *faculty*, or, as some call it, the *equity of redemption*, is reserved, are only a kind of pignorative contracts.

A certain time is limited, within which the faculty of redemption shall be exercised; and beyond which it shall not extend.

REDEMPTION, in *Theology*, denotes the recovery of mankind

kind from sin and death, by the obedience and sacrifice of Christ, who on this account is called the *Redeemer* of the world. See COVENANT.

REDEMPTIONS, *Redemptiones*, in our old *Law Writers*, denote grievous mulcts imposed by way of commutation for the head or life of the delinquent.

REDEMPTION of the National Debt. See FUND.

REDEN, or REDZYN, in *Geography*, a town of Prussia, in the territory of Culm; 20 miles N.E. of Culm.

REDENS, REDANS, or *Redant*, in *Fortification*, a kind of work indented in form of the teeth of a saw, with salient and re-entering angles; to the end that one part may flank or defend another.

It is also called *saw-work*, and *indented work*. The faces in this flank one another.

Redens are frequently used in the fortifying of walls, where it is not necessary to be at the expence of building bastions; as when they stand on the side of a river, a marsh, the sea, &c. But the fault of such fortification is, that the besiegers from one battery may ruin both the sides of the tenaille or front of a place, and make an assault without fear of being enfiladed, since the defences are mined.

The parapet of the corridor also is frequently redented, or carried on by way of redens.

REDES, in *Geography*, a river of South America, which runs into the gulf of Darien, N. lat. $7^{\circ} 37'$. W. long. $76^{\circ} 40'$.

REDHIBITION, REDHIBITIO, in the *Civil Law*, an action allowed a buyer, by which to annul the sale of some moveable, and oblige the buyer to take it back again, upon the buyer's finding it damaged, or that there was some personal cheat, &c.

The redhibition, or redhibitory action, has a place in several cases, in the body of the civil law. If a horse was sold that had the glanders, were broken-winded, or foundered, it was a redhibitory case; and the seller might be obliged to take him again within nine days.

REDI, FRANCIS, in *Biography*, an Italian physician, was descended from a noble family, and born at Arezzo, in Tuscany, in the year 1626. He commenced his studies at Florence, and then removed to Pisa, for the prosecution of his philosophical and medical pursuits, where he received the degree of doctor in both these sciences. He had acquired great reputation both in science and literature, and was induced to settle at Florence, where he at length gained the favour of the court, and was appointed first physician to Ferdinand II. duke of Tuscany, and subsequently to Cosmo III. These appointments and his constant professional employment did not, however, prevent him from cultivating his favourite study of the belles lettres. He devoted much of his time to the language of his country, and contributed not a little to the perfection of the dictionary of the academy of La Crusca, of which, and of several other learned bodies, he was a member. Totally free from presumption, and attached to every cultivator of learning and science, he was always ready to give his assistance to them in every way he could, and was universally esteemed and beloved. He displayed both in his practice, and in the prosecution of his inquiries in natural history, a singular acuteness of observation, and a complete incredulity as to the marvellous, which was so prevalent in his time; and he cautioned his friends and pupils against the popular errors in this respect. Although he was afflicted with epileptic fits in his latter years, yet he appears neither to have abandoned his studies, nor his professional business, until his death, which took place in 1697, in his 71st year.

Redi was the author of several Italian poems, which are

held in much estimation. His other works were all written in Italian, and his style was deemed so pure and elegant, that the authors of the dictionary of La Crusca have often cited it as a standard. Most of his writings on natural history have been translated into Latin; especially his "*Experimenta circa Generationem Insectorum, cum Figuris Aëcis*;" his "*Observationes de Viperis*;" his "*Experimenta circa diversas Res naturales, speciatim illas quæ ex Indiis adferuntur*;" and his "*Observationes de Animalibus viventibus, quæ intra Animalia viventia reperiuntur*." He also published a letter on the Use of Spectacles, and an Essay on Styptics. Eloy Dict. Hist. de la Med.

Redi, in the notes to his "*Bacco in Torcano*," a dithyrambic poem, published in 1685, has given many curious etymologies and explanations of the musical terms used by the Italians in early times.

REDIGOODÉM, in *Geography*, a town of Hindoostan, in the circar of Ellore; 25 miles W. of Ellore.

REDIMICULUM, among the Romans, a girdle, which going about the neck, divided on the breast, and passing down each side, went round, and kept the robe tight to the body.

REDINKA, in *Geography*, a town of Portugal, in the province of Beira; 14 miles S. of Coimbra.

REDINTEGRATED MEDALS. See MEDAL.

REDINTEGRATION, REDINTEGRATIO, in the *Civil Law*, the act of restoring a person to the enjoyment of a thing, of which he had been illegally dispossessed.

In France, where a person is despoiled of his property, he claims it again by redintegrand, or action of restitution. But the redintegrand must be demanded within a year and a day, otherwise it is precluded.

REDINTEGRATION, in *Chemistry*, the restoring of any mixed body, or matter, whose form has been destroyed by calcination, corrosion, sublimation, or the like, to its former nature and constitution.

The redintegration of mercury is properly called *revivification*. Mr. Boyle has an express treatise on the redintegration of saltpetre; where he shews, that after reducing it by fluxion into fixed nitre, which is next of kin to salt of tartar in all its properties, he could presently redintegrate it, by pouring a sufficient quantity of spirit of nitre on it; *i. e.* he could re-produce true crystals of the usual form and virtue of saltpetre.

It is a strong objection against the chemical principles, that we cannot redintegrate the body they were procured from, by re-mixing them.

This seems to argue, that the body did not properly consist of such elements, or that they were not originally contained in it, but were rather produced by the fire.

REDIPATAM, in *Geography*, a town of Hindoostan, in Marawar; 18 miles N. of Ramadnapuram.

REDIRE *ad Pacem*, in *Law*, is applied to a person, whose outlawry is reversed, and who is restored to the king's peace.

REDISSEISIN, a disseisin made by him who once before was found and adjudged to have disseised the same man of his lands or tenements; for which there lies a special writ, called a *writ of redisseisin*. See ASSISE of Novel Disseisin, DISSEISIN, and POST-Disseisin.

REDMANS, or RADMANS, in Doomsday and other ancient books, are probably the same with rod, or rad-knights; *viz.* men who, by the tenure or custom of their lands, were to ride with, or for, the lord of the manor, about his business.

REDNITZ, in *Geography*, a river of Germany, formed by the union of the Upper and Unter Restat, about 5 miles S. of Roth, in Franconia. After receiving in its course several

several streams, it discharges itself into the Maine, a little below Bamberg.

REDOLESCO, a town of Italy, in the department of the Mincio; 14 miles W.S.W. of Mantua.

REDON, a town of France, and principal place of a district, in the department of the Ille and Vilaine; 32 miles S.S.W. of Rennes. The place contains 3783, and the canton 11,620 inhabitants, on a territory of $187\frac{1}{2}$ kilometres, in 5 communes. N. lat. $47^{\circ} 39'$. W. long. 2° .

REDONDA, an island in the West Indies, about 10 miles in circumference, without ports, rivers, or towns. N. lat. $16^{\circ} 55'$. W. long. $62^{\circ} 20'$.

REDONDELA, or **REDONDILLO**, a town of Spain, in the province of Galicia, near the west coast, defended by a strong castle; 32 miles W.S.W. of Orensa.

REDONDO, a rock, about three miles in circumference, between the islands of Montserrat and Nevis, in the West Indies. N. lat. $17^{\circ} 6'$. W. long. $61^{\circ} 35'$.

REDONDO Novo, a town of Benguela. S. lat. $11^{\circ} 22'$. E. long. $13^{\circ} 45'$.

REDONDO, O, a town of Portugal, in Alentejo; 14 miles E.N.E. of Evora. N. lat. $38^{\circ} 33'$. W. long. $7^{\circ} 22'$.

REDONDOS, a town of Portugal, in the province of Beira; 17 miles S. of Coimbra.

REDOUBLE', Fr., in *Musiq.* a doubled interval in the octave above a single interval. The octave of the octave, with us, is called the 15th. See **INTERVAL**.

REDOUBT, or **REDOUTE**, *Reductus*, in *Fortification*, a small square fort, without any defence but in front, used in trenches, lines of circumvallation, contravallation, and approach; as also for the lodging of corps de garde, and to defend passages. See **FORT**.

They are usually figures of three, four, five, or six sides, encompassed with a ditch, and a bank of earth, which consists of two parts, called rampart and parapet.

In marshy grounds, redoubts are often made of stone-work, for the security of the neighbourhood; their face consists of from ten to fifteen fathoms; the ditch round them from eight to nine feet broad and deep; and their parapets, which are cut into embrasures and merlons, have the same thickness. See **REDUCT**.

The inner sides of square redoubts are usually between the limits of twelve and thirty-two yards; and when they are to be defended by musketry, the number of men necessary to the defence may be thus determined: half the side squared gives the number of troops; and twice the square root of a given number of men, shews the length in yards of the side of a square redoubt proper to contain them.

To construct a square redoubt.—Mark out a square, whose side is adapted to the number of troops allotted for the defence, as *AB* (*Plate VII. Fortification, fig. 5.*) for the inside of the rampart. About this square, at the distance of ten or twelve feet, describe another square, whose side, *CD*, is the inner boundary of the parapet; make a parapet of about nine or ten feet thick, whose outline is the line *EF*; leave a berm about three or four feet broad, whose side is *GH*; and dig a ditch about sixteen feet wide, and about six or seven feet deep, which should be rounded before the angles of the redoubt. Make the rampart from four feet to nine or ten feet high; let the parapet be six or seven feet higher, and let the foot-bank be four feet and a half lower than the crown of the parapet. On that side most secure from the enemy, make a bridge across the ditch, and a passage through the rampart, about four or five feet broad when the defence is musketry, about nine or ten feet broad when cannon are to be used; and shut up the passage by a strong gate. If the redoubt is to be defended by can-

non, both the rampart and parapet should be at least five or six feet thicker. In order to make the fire pretty nearly equal on all sides, and sufficient for defending the angles of the work, *M. Clairac* has contrived to cut the inside of the parapet into notches, whose two sides, of a yard each, are at right angles to one another, and make half-right angles with the sides of the work; the manner of which, and its defence, are plainly shewn in the figure, where the lines with dots at the ends represent the fire three different ways from the same side.

For the method of constructing flanked redoubts, see **FORT**.

A detached redoubt is a kind of work resembling a ravelin, with flanks, placed beyond the glacis; such as *B* (*Plate V. Fortification, fig. 6.*) They are made in order to occupy some spot of ground which might be advantageous to the besiegers; and likewise to oblige the enemy to open their trenches farther off than they would otherwise do. Their distance from the covert-way ought not to exceed a hundred and twenty toises, that they may be defended by musket-shot from thence. The gorge, *ab*, is forty toises; the flanks, *ac*, *bf*, which are perpendicular to the gorge, ten; and the faces, *ed*, *fd*, thirty: the ditch before it is six toises, ending in slopes at both ends; the covert-way, four; the branches of the covert-way about forty-two toises long; the faces of the places of arms, *y*, *y*, which are perpendicular to the branches, ten; and the other, which is parallel to them, fourteen. The communication from the covert-way to the redoubt is five or six toises wide; and there is a traverse made just at the entrance, and another in the middle when it is pretty long. The parapets of this communication terminate in a slope or glacis. *Robertson's Marine Fortif. p. 20, &c. Muller's Fort. p. 43, &c. See ARROW.*

Redoubts are also small works of the same form made in a ravelin.

REDOUBT, Castle or Donjon. See **REDUCT**.

REDOUTES en Cremailiere, differ from other redoubts by having the inside line of the parapet broken, so as to resemble a pot-hook, or the teeth of a saw; by which a greater fire can be brought to bear upon the defile than if only a simple face was opposed to it, and consequently the passage is rendered more difficult.

REDOUTES de Terre, Fr. redoubts that are hastily thrown up, and made with earth, for the purpose of securing entrenchments, circumvallations, passages of rivers, &c.

REDOUTES de Maconnerie, Fr. redoubts made of mason-work; generally constructed in places where an enemy might derive advantage from establishing himself; they are likewise built upon the salient angles of the glacis.

REDOUTES Casematées, Fr. casemated redoubts, or such as are arched over and made bomb-proof. Those constructed for the defence of Gibraltar, and for the security of Dover castle, are of this description.

REDOUTES à Machicoulis, Fr. are those which are made of brick or stone-work several stories high. The highest story juts out about one foot beyond the wall that surrounds or fronts the redoubt.

REDRESSING, the rectifying or setting any thing straight again.

Trees and other plants have a natural faculty of redressing themselves, when, by any external cause, they are forced out of the perpendicular.

In the moral sense, to redress grievances, is to reform or remove them. The redress of injuries is the object with a view to which courts of justice are instituted in every civilized society; in order to protect the weak from the insults of the stronger, by expounding and enforcing those laws, which define rights and prohibit wrongs. This remedy is, therefore,

therefore, to be fought for by application to these courts; that is, by civil suit or action.

To redress a stag, among hunters, is to put him off his changes.

REDRILL, *To*, in *Military Language*, is to put a soldier through the first elements of military training. Every soldier, after his return from long absence, must be redrilled before he is permitted to act in the ranks of a company.

REDRUTH, in *Geography*, a considerable market-town in the east division of the hundred of Penwith, and county of Cornwall, England, is situated on the road from Launceston to the Land's-End, at the distance of 262 miles S.W. from London. It occupies the declivity of an eminence in the very centre of the mining district, and derives its support entirely from the mines. Dr. Pryce supposes it to have been a town in Saxon times; but if so, the records of its history during that period have been entirely lost. It is first mentioned in the year 1332, when William Bassett, the then proprietor of the manor, obtained for the inhabitants the privilege of fairs and markets. In 1502 a similar grant was made in favour of John Bassett, esq.; and in Oliver Cromwell's time, Mr. Buller of Morrall procured a charter for a market on Fridays, which was confirmed by king Charles II. At present there are two weekly markets, held on Wednesday and Friday; and three annual fairs, chiefly for cattle and oxier manufactures. The tolls of two of these fairs and the markets belong to the Buller family; and the other fair to lord de Dunstanville, the descendant of the Bassetts. The increase of this town, since the commencement of the copper mines in the last century, has been as six to one, as appears by the average of baptisms. According to the population return of 1801, it contained 664 houses, and 4924 inhabitants; but in 1811 the houses were returned as amounting to 879, and the inhabitants to 5903 in number.

Redruth consists chiefly of one long street. The church, the living of which is a rectory, was built, in 1770, by lord de Dunstanville, in the stead of a more ancient one. This building is situated about half a mile from the town. Here are the remains of a chapel of ease, dedicated to St. Rumon, which has been unroofed for many years. In Redruth are meeting-houses for Quakers and Anabaptists, besides two for Methodists in the town, and a third in the north part of the parish. In 1803, a large school-house was built here by subscription, and a master placed in it by the same means; but the subscription having been discontinued, the school is now kept open by the master on his own account.

Among the numerous mines in Redruth and the contiguous parishes of Gwennap, Kenwyn, and St. Agnes, those denominated the *Gwennap mines* are considered to be the principal. These lie to the south-east of Redruth, in a part of the county where the tin and copper lodes are peculiarly rich, and in some places intersect each other. The country of the united mines Huel-Virgin, Poldice, and Huel-Unity, is schistus; that of Huel-Jewell, Huel-Gorland, and Truscavan, is granite; and it has been remarked, that the metallic veins mostly obey the course of the granite mountains, and run very nearly parallel with them. The united mines employ about 600 men, of whom 400 work under ground. The water is drawn off by four immense beam-engines, one of the cylinders of which is nearly seven feet in diameter. The Huel-Virgin mine is 160 fathoms deep, and is extremely productive; but the Huel-Unity and Poldice mines are still more rich, and are wrought to such advantage, that the proprietors usually share from 16,000*l.* to 20,000*l.* per annum. The depth of the Poldice mine is 170 fathoms; but at present it is not worked at a lower

depth than 140. This is one of the oldest mines in the county, and yields a yellowish copper ore, a rosin tin, and a few stones of galena. The Huel-Gorland mine is 120 fathoms below the surface, and is wrought at the expence of about 1000*l.* a month. The North Down mines, nine in number, occupy an extent of two miles in length, and one in breadth, and have their surplus water carried away by the same long adit which runs through the Gwennap mines to the Carnon-Stream works.

Besides the mines, there are several other objects in the vicinity of Redruth not undeserving of notice. Portreath, about four miles to the north, is a small sea-port for the importation of coals and lime, and the exportation of copper ore to the works in Wales. It is defended by a fort, mounting four guns, and was erected by lord de Dunstanville in the year 1782, and is maintained at his expence. Tehidy park, the ancient seat of the Dunstanville family, adjoins Portreath on the south-west. This manor is first mentioned as being in their possession as early as the year 1100, about thirty years before the marriage of Cecilia de Dunstanville with William Bassett, who carried the Dunstanville estates to the Bassetts. The present manor-house is of modern erection, consisting of a centre, and four detached pavilions at the angles, the whole constructed chiefly of Cornish free-stone. The principal rooms are decorated with some good portraits by Vandyke, Kneller, and sir Joshua Reynolds; and also with a few pieces by Rubens, Carlo Dolce, Bononi de Ferrari, Rembrandt, Borgognone, and others of less note. The park and pleasure grounds attached to this mansion are very extensive; containing about seven hundred acres, finely varied by wood and lawn, and appearing like a well-cultivated garden in the midst of a desert.

Westward from Redruth, about a mile and a half, is Carn-breh hill, which Dr. Borlase and others contend ought to be regarded as the grand centre of Druidical worship in this county, almost every kind of monument commonly attributed to the Druids being found, as they allege, upon that eminence. How far this opinion is correct, we shall not pretend to decide; but we may observe, that several late writers maintain, that a part of the supposed monuments of religion, *viz.* the caves, are in fact the result of natural convulsion. No doubt, however, some of them are artificial, and probably belonged to the Druids; and what seems to corroborate this idea is, the circumstance of Redruth being a corruption for Dre-Druith, which signifies the Druids' town. On the summit of this hill is a circular fortification, called the Old Castle, which appears to have been formerly surrounded by a strong wall; and about 300 yards to the eastward, on a ledge of succumbent rocks, stands Carn-breh castle, part of which lays claim to a very high antiquity; but the remainder is of comparatively modern date. The rocks upon which this structure is erected not lying at all contiguous to each other, are connected by massive circular arches thrown over the cavities.

On the south-west side of Carn-breh hill is Pendarves, the seat of John Stackhouse, esq. It is a large handsome building, situated on an eminence commanding extensive views over the western parts of the county. In a field contiguous is a large cromlech, composed of three upright stones, and an impost. Clowance, situated about three miles further to the south-west, has been for several centuries a seat of the family of St. Aubin. The house is deeply embosomed in wood; and contains, besides several pictures of curiosity and value, a large collection of rare and choice prints, accumulated in the portfolios of its present possessor. Lysons's *Magna Britannia*, vol. iii. London, 1814, 4to.

Banties of England and Wales, vol. ii. by John Britton and E. W. Brayley.

REDSEAR. See IRON.

REDSTONE, in *Geography*, a town of Pennsylvania, on the Monongahela; 55 miles N.W. of Pittsburg.

REDUBBORS, those who buy stolen clothes, &c. and, to the end they may not be known, turn them into some other fashion, &c. See FRIPPERY, and REGRATOR.

REDUCE, in *Chemistry*. See REDUCT.

To REDUCE a Place, in *Military Language*, is to oblige the governor to surrender it to the besiegers by capitulation.

To REDUCE the Circle, is to restore or bring back a battalion or company which has been formed in circle to its original position in line.

To REDUCE the Square, is to restore a battalion or battalions which have been formed in a hollow or oblong square to their natural situation in line or column.

REDUCED CHART. See CHART.

To be REDUCED, in *Military Language*, is to be taken off the establishment, or cease to receive pay as soldiers. When a regiment is reduced, the officers are generally sent upon half pay. Sometimes, as at the close of a war, the corps are reduced, and the officers remain upon full pay. Hence are derived the expressions *in* and *out* of the break. In the break denotes the liability of being reduced: *out of the break* signifies the certainty of being kept upon the establishment.

To be REDUCED to the Ranks, is to be taken from a superior appointment in a regiment, and to be ordered to the duty of a common soldier. This sometimes happens by way of punishment, when a serjeant or corporal misbehaves. A serjeant, however, cannot, at present, be reduced, except by sentence of a regimental court-martial.

REDUCING SCALE, is a thin broad piece of box, with several lines and scales of equal parts upon it; for turning chains and links into acres and rods, by inspection.

It is used by surveyors to reduce maps and draughts from one dimension to another; it is sometimes also called a *surveying scale*.

REDUCT, REDUIT, or *Redoubt*, a military term, signifying an advantageous piece of ground, intrenched and separated from the rest of the place, camp, &c. for an army, garrison, &c. to retire to, in case of a surprise. Reduits have been sometimes made for the purpose of securing different posts in a town independent of its citadel. They were proposed by the celebrated Vauban. See DONJON.

REDUCT, in *Building*, a kind of recess, or little place, taken out of a larger, to make it more uniform and regular; or for some other convenience, as for a little cabinet aside of a chimney, for alcoves, &c.

REDUCT, or *Redux*, among *Chemists*, is a powder by which calcined metals and minerals are reduced again to their regulus, or pure substance.

REDUCTION, REDUCTIO, in the *Schools*, a manner of bringing a term or proposition, which before was opposite to some other, to be equivalent to it.

Reduction is effected by the addition or retrenchment of a negative particle. Thus, to reduce this proposition, *no man is an animal*, to be equivalent to its opposite, *every man is an animal*, I drop the negative, and say, *man is an animal*. After the like manner might the term *every man* be reduced, by adding the negative and saying, *there is no man*.

REDUCTION of Propositions is used in a more general sense, for any expression of one proposition, by another proposition equivalent to it.

To a reduction, therefore, there are two propositions required, the *reduced*, and the *reducing*; which are considered as the extremes of it, and to be connected in the reduction by

means of the particle *that is*; which here has the effect of a copula.

As here, *only animals think; that is, animals think, and nothing besides animals thinks*. Where the proposition preceding the particle is reduced, and the subject of the reduction; that following the particle reduces, and has the effect of the predicate of the reduction, and the particle *that is* acts as a copula, importing, not barely that the proposition is expressed by another, but by another equivalent one, or, as it were, the same.

REDUCTION of Syllogisms, is a regular changing or transforming of an imperfect syllogism into a perfect one. Or, it is a change of a syllogism in respect of form, by which the necessity of the illation, or inference, is made more evident.

Reduction obtains in syllogisms of the second and third figure; as also in the indirect modes of the first. By it these are all brought to the first.

There are two kinds of this reduction; the one *direct*, or *ostensive*, performed merely by a conversion of one or both the premises, or by a transposition of them; as when *camelres* is reduced to *celarent*: the other *indirect*, called *per impossibile*, or *ad absurdum*; by which the person who denies the goodness and legitimacy of an imperfect syllogism, is reduced to assert or grant something absurd and impossible, or contradictory to some other thing maintained by him.

Suppose, *e. gr.* a person granting the premises of the following syllogism, denies the conclusion: *All fraud is prohibited; but some trading is not prohibited; therefore some trading is not fraud*. We thus proceed against him if the syllogism be not good, the antecedent is just, but the consequent false; and, therefore, the contrary of the conclusion must be true: now I take the contrary of the conclusion, which you thus give, *viz. all trading is fraud*; and of that, with the other premise of the former syllogism, *viz. the major*, which you likewise grant, make a new syllogism; thus, *All fraud is prohibited; all trading is fraud: therefore all trading is prohibited*. But this proposition, *all trading is prohibited*, and the other, *some trading is prohibited*, which you granted me in the first syllogism, are contradictories.

REDUCTION, in *Arithmetic*, is the converting of monies, weights, or measures, into the same value in other denominations; *e. gr.* pounds into shillings and pence; or shillings and pence into pounds.

The reductions of the principal monies, coins, weights, and measures, ancient and modern, foreign and domestic, are found under COIN, WEIGHT, MEASURE, POUND, FOOT, &c.

Reduction is of two kinds: 1. *Descending*, when a quantity is to be brought from a higher denomination to a lower.

This is done by considering how many of the next less denomination are contained in the next greater before, and by that number multiplying the greater.

Thus pounds are reduced into shillings, by multiplying by 20; shillings into pence, by multiplying by 12; and pence into farthings, by multiplying by 4.

Troy pounds are reduced into grains, by multiplying by 12, 20, and 24: and avoirdupois hundreds into ounces, by 4, 28, and 16.

2. *Ascending*, when a lower denomination is to be reduced to a higher.

In order to this, the business is to divide the least by so many of its denomination as are contained in the next greater: thus, 24,720 pence, divided by 12, and the quotient by 20, gives 103 pounds.

If there remain any thing in each division, it is respectively

ively either odd pence, or shillings: thus, 6713 pence reduced, give 27l. 19s. 5d. cut off the last, the rest are the pounds required.

To expedite the practice, several compendious ways of reduction have been invented. See PRACTICE.

Thus, yards are turned into ells by subtracting a fifth; and into ells Flemish by adding a fifth. Ells Flemish are reduced into yards by subtracting a quarter. Ells Flemish reduced to ells English by multiplying by 6, and cutting off the right-hand figure.

Great pounds of silk of twenty-four ounces are reduced to pounds of sixteen ounces by adding one-half; and pounds of sixteen ounces into pounds of twenty-four by subtracting one-third.

REDUCTION of Decimals. See DECIMALS.

REDUCTION of Fractions. See FRACTIONS.

REDUCTION of Ratios. See RATIOS, *Reduction of*.

REDUCTION of Surds. See SURDS.

REDUCTION of Equations. Various algebraical operations are classed under this head by different authors; some considering it to be the same as is otherwise, and more properly, called the *solution* of equations, or the finding of their roots: some define it to be the taking away or exterminating all the unknown quantities except one, otherwise called *elimination*: others again, under this head, treat of what is more usually termed the *transformation* of equations; and others again apply it to the depressing of an equation, or the reduction of it to another of lower dimensions, which latter seems to us the only operation that can properly be treated of under the above designation. See RESOLUTION, and TRANSFORMATION.

There are but few cases in which the reduction of an equation can be effected, *viz.* only when a known relation has place amongst any of its roots, in which case the equation will admit of being reduced as many degrees lower, as there are independent conditions known to have place. So that if the relation be only between two roots, which is one condition, the equation may be reduced two degrees; if the relation extend to three roots, it may be reduced three degrees; and so on.

The conditions or relations more commonly considered, are those in which the roots of an equation form an arithmetical or geometrical progression, and when an equation has any number of equal roots. The two former relations seem rather objects of curiosity than utility, as it is not probable that an equation should have such relations obtain between its roots; but with regard to equal roots they may frequently arise in the solution of various problems. When any geometrical or physical problem is proposed, the number of its possible solutions is generally limited, and therefore the ultimate result arising out of such investigation ought to be an equation, the number of whose roots agree with the limited number of solutions. But it may happen that the analyst, by not pursuing the best mode of operation, is led to an equation of higher dimensions than is requisite, in which cases, upon investigation, it will always be found that his resulting equation has some number of equal roots, which being taken away, will reduce the equation to one of lower dimensions, which gives the proper number of solutions to the original problem. As to the cases in which the roots of an equation form a geometrical progression, they occur almost exclusively in the solution of binomial equations, having prime indices, a property which M. Gauss has turned to a good account in the solution of these equations. See POLYGON, and RECIPROCAL Equations.

Nearly all other relations between the roots of equations

are feigned for the purposes of framing questions, and exercising the ingenuity of authors and their students.

1. To ascertain whether a proposed equation has any equal roots.

Let $x^m + \alpha x^{m-1} + \beta x^{m-2} + \gamma x^{m-3} + \&c. = 0$, be any equation whose roots are $a, b, c, d, \&c.$ then from the known theory of equations we have

$$x^m + \alpha x^{m-1} + \beta x^{m-2} + \gamma x^{m-3} + \&c. = (x-a)(x-b)(x-c)(x-d), \&c.$$

And it may be shewn also, that the equation $m x^{m-1} + (m-1) \alpha x^{m-2} + (m-2) \beta x^{m-3} + \&c. =$

$$\begin{aligned} &(x-a)(x-b)(x-c) \&c. + \\ &(x-a)(x-b)(x-d) \&c. + \\ &(x-a)(x-c)(x-d) \&c. + \\ &(x-b)(x-c)(x-d) \&c.; \end{aligned}$$

that is, it is equal to the sum of all the m equations that can be formed by the different combinations of the m first roots, taking $m-1$ at a time. (See Waring's *Meditationes Algebraicæ*, cap. 3.) Now if we suppose the first equation to have two equal roots, as, for example, $a=b$, the above products will become

$$\begin{aligned} &x^m + \alpha x^{m-1} + \beta x^{m-2} + \gamma x^{m-3} + \&c. = \\ &(x-a)(x-a)(x-c)(x-d) \&c. \text{ and} \\ &m x^{m-1} + (m-1) \alpha x^{m-2} + (m-2) \beta x^{m-3} + \&c. = \\ &(x-a)(x-a)(x-c) \&c. + \\ &(x-a)(x-a)(x-d) \&c. + \\ &(x-a)(x-c)(x-d) \&c. + \\ &(x-a)(x-c)(x-d) \&c.; \end{aligned}$$

where it is obvious that both the one and the other of these equations have the same factor, *viz.* $(x-a)$.

If the equation had three equal roots, it is equally obvious that both equations would have the common factor $(x-a)^2$; and generally, if the equation had p equal roots, they would both have the common factor $(x-a)^{p-1}$.

Therefore, when it is proposed to find whether a given equation have equal roots, we must from the proposed equation draw the *derived* equation as above, (which, it will be observed, is the same as would arise from taking the fluxion of the first, leaving out of course the x 's,) and find by the usual methods, whether these two functions have any common measure; which, if they have, will furnish us with the equal root sought; and consequently the original equation may then be reduced by division to another of two degrees lower dimension for two equal roots; of three degrees lower for three, and so on.

Exam. 1.—It is required to find the equal roots of the equation $x^3 - 48x - 128 = 0$.

Here the derived equation is $3x^2 - 48 = 0$, and the common measure of these two functions is $x+4$; whence -4 and -4 are the equal roots; the third root being $+8$.

Exam. 2.—It is required to ascertain whether the equation

$$x^4 + 3x^3 - 14x^2 - 12x + 40 = 0$$

have equal roots, and what they are.

Here the derived equation is

$$4x^3 + 9x^2 - 28x - 12 = 0;$$

and the common divisor of the two is $x-2$; whence $x=2$, which are two of the equal roots. Divide now the original equation by $x^2 - 4x + 4$, and we have

$$x^2 + 7x + 10 = 0,$$

whose

whose roots are -2 , and -5 ; therefore, the four roots of the proposed equation are $2, 2, -2, -5$.

If the roots of an equation be equal, but with contrary signs, the operation is more simple. For, in this case, we have only to change the signs of the roots in the proposed equation, by changing the alternate signs of its co-efficient; and we shall thus have two equations, having necessarily a common quadratic factor of the form $x^2 - a^2$, which may be found, and the equation depressed as before.

Exam. 3.—Required the roots of the equation $x^4 + 3x^3 - 7x^2 - 27x - 18 = 0$, two of which are equal, but with contrary signs.

By changing the signs of the alternate terms, we have $x^4 - 3x^3 + 7x^2 + 27x - 18 = 0$, the common quadratic divisor of which is $x^2 - 9 = 0$; whence the equal roots with contrary signs are $+3$, and -3 . Now dividing the proposed equation by $x^2 - 9$, we have $x^2 + 3x + 2 = 0$;

whence $x = \frac{-3}{2} \pm \sqrt{\frac{1}{4}} = -2$, and -1 , which are the other two roots.

On this subject the reader should consult Waring's *Meditationes Algebraicæ*, cap. 3. See also Bonnycautle's *Algebra*, vols. i. and ii.

REDUCTION of Interest of the public Debt. See **FUND**.

REDUCTION of Curves. See **CURVE**.

REDUCTION of a Figure, Design, or Draught, is the making a copy of it, either larger or smaller than the original, still preserving the form and proportion.

The great use of the proportional compasses is in the reduction of figures, &c. whence they are also called *compasses of reduction*.

There are various methods of reducing figures, &c.; the most easy is by means of the *pentagraph* (which see), or parallelogram: but this has its defects. The best and most usual methods of reduction are as follow:

To reduce a figure, as *ABCDE* (*Plate XII. Geometry, fig. 5.*) *into a less compass*.—About the middle of the figure, as *z*, pitch on a point; and from this point draw lines to its several angles, *A, B, C*, &c. then drawing the line *ab* parallel to *AB*, *bc* parallel to *BC*, &c. you will have the figure *abcde* similar to *ABCDE*.

If the figure *abcde* had been required to be enlarged, there needed nothing but to produce the lines from the point beyond the angles, as *zD, zC*, &c. and to draw lines, *viz. DC, CB*, &c. parallel to the sides *dc, cb*, &c.

To reduce a figure by the angle of proportion.—Suppose the figure *ABCDE* (*fig. 6.*) required to be diminished in the proportion of the line *AB* to *ab* (*fig. 7.*): draw the indefinite line *GH* (*fig. 8.*), and, from *G* to *H*, set off the line *AB*; on *G* describe the arc *HI*; set off the line *ab* as a chord on *HI*, and draw *GI*. Then with the angle *IGH* you have all the measures of the figure to be drawn. Thus to lay down the point *c*, take the interval *BC*, and upon the point *G* describe the arc *KL*; also on the point *G* describe *MN*; and upon *a*, with the distance *MN*, describe an arc cutting the preceding one in *c*, which will determine the side *bc*. And after the same manner are all the other sides and angles to be described. The same process will also serve to enlarge the figure.

To reduce a figure by a scale.—Measure all the sides of the figure, *e. gr. ABCDE*, by a scale, and lay down the same measures respectively, from a smaller scale in the proportion required.

To reduce a map, design, or figure, by squares.—Divide the original into little squares, and divide a fresh paper of the dimensions required, into the same number of squares;

which are to be larger or less than the former, as the map is to be enlarged or diminished.

This done, in every square of the second figure, draw what you find in its correspondent one in the first.

REDUCTION to the Ecliptic, in *Astronomy*, is the difference between the argument of latitude, as *NP* (*Plate XIX. Astronomy, fig. 10.*) and an arc of the ecliptic *NR*, intercepted between the place of a planet and the node *N*.

To find the reduction.—The angle of inclination *PNR*, and the argument of latitude *NP*, being given, find, by the doctrine of spherics, the arc *NR*; subtract *NR* and *NP* from each other, the remainder is the reduction.

REDUCTION into first Matter, is a term which alchemists formerly used, when they found their substances putrefy, and grow black.

REDUCTION was more particularly used for the conversion of a dry matter into a liquid, particularly into water; which by the alchemists was held the principle of all things.

The reduction of metals into their first matter, or principles, according to these philosophers, can only be effected by mercury; nothing else being able to loosen the fixed sulphur of metallic bodies, which binds them together.

REDUCTION, in *Metallurgy*, is the decomposition of a metallic oxyd, so as to leave the metal in a state of greater or less purity, and exhibiting the lustre which is so eminently characteristic of metallic bodies.

Reduction is, for the most part, effected by charcoal and a high temperature, either with or without the assistance of fluxes. For the various modes of reduction in actual practice, see the articles of the different metals.

REDUCTION, in *Surgery*, denotes an operation by which a dislocated, luxated, or fractured bone is restored to its former place. Reduction, or *reposition*, is always to be performed before any remedy be applied.

REDUIT, in *Military Affairs*. See **REDUCT**.

REDUNDANCY, or **REDUNDANCE**, a fault in discourse, consisting in the use of a superfluity of words.

Words perfectly synonymous are redundant, and ought to be retrenched. Redundancy necessarily makes the style weak and languid. See **PLEONASM**.

REDUNDANT HYPERBOLA, in *Geometry*, is a curve of the higher kind, thus called, because it exceeds the conic section of that name in the number of its hyperbolic legs; being a triple hyperbola, with six hyperbolic legs.

REDUNDANT Interval, in *Musick*, is used for an interval exceeding the truth by a comma.

Some apply redundant to an interval exceeding a diatonic interval by a semitone minor; but this is more usually called a superfluous interval. See **INTERVAL** and **SECOND**.

REDUPLICATION, in *Rhetoric*, a figure by which a verse begins with the same word as the preceding one ends with. See **ANADIPLOSIS**.

REDUPLICATION, in *Logic*, is a kind of condition expressed in a proposition, indicating or assigning the manner in which the predicate is attributed to the subject.

The usual reduplicative words are *quatenus, as, so far as, considered as, inasmuch as*, &c. Hence,

REDUPLICATIVE PROPOSITIONS, are such in which the subject is repeated, with some circumstances or condition. Thus, *Men, as men, are rational; kings, as kings, are subject to none but God*.

REDUTEA, in *Botany*, so called by the late M. Ventenat, in honour of his friend M. P. J. Redouté, one of the most accurate and intelligent botanical draughtsmen, and perhaps the finest botanical painter, ever known. He is the author of a splendid coloured work in folio, on the Liliaceous

liaceous tribe, including some other beautiful plants allied thereto, which has already extended to the seventh volume; and it is to his pencil that the perfection of most botanical works that have appeared in France, for near thirty years past, particularly the publications of L'Heritier and Ventenat, is owing.—Venten. Jard. de Cels, 11. Poiret in Lamarck Dict. v. 4. 87.—Class and order, *Monadelphia Polyandria*. Nat. Ord. *Columnifera*, Linn. *Malvacea*, Juss.

Gen. Ch. *Cal.* Perianth inferior, double, permanent: the outer of many minute leaflets: inner much larger, of one leaf, in five very deep segments. *Cor.* Petals five, roundish kidney-shaped, imbricated obliquely, united at the base to each other, and to the column of the stamens. *Stam.* Filaments numerous, united below into a conical tube, subdivided and branched above; anthers kidney-shaped. *Pist.* Germen superior, ovate, simple; style thread-shaped, swelling upwards, about as long as the stamens; stigmas three, obtuse. *Peric.* Capsule ovate, of three cells and three valves, the partitions from the middle of each valve. *Receptacles* of the seeds three, inserted into the base of the capsule, alternate with the valves, and nearly equal to them in length, linear, bearing seeds on each edge. *Seeds* six or eight in each cell, obovate, minutely stalked, inserted in two rows on the receptacle, each clothed with dense wool.

Eff. Ch. Calyx double; the outer of many minute leaves; inner in five deep segments. Stigmas three. Capsule of three cells and three valves. Seeds enveloped in wool. Receptacles three, linear, unconnected with the valves.

Obs. Ventenat considers the three distinct receptacles, as affording the most essential distinction, between this and every other malvaceous genus. The woolly seeds, moreover, distinguish it from all except *Gossypium*, whose large three-leaved outer calyx is abundantly different from *Redutea*.

The only known species is

1. *R. heterophylla*. Various-leaved Redutea. Vent. Jard. de Cels, t. 11.—Discovered by Riedlè in the island of St. Thomas, and raised in M. Cels's garden at Paris. The plant is herbaceous and annual, and M. Ventenat seemed to think it might serve to decorate our flower-borders, like other annuals of very hot climates, in the open air, being, we presume, raised on a hot-bed in the spring. Every part of the herbage is besprinkled with small, whitish, fringed scales, readily seen with a magnifying glass. The root is spindle-shaped, yellowish. Stem erect, twelve or fifteen inches high, about the size of a goose-quill, angular, pithy, branched, leafy, dark green, many-flowered. Leaves alternate, on longish stalks, spreading widely, ovate, undivided or three-lobed, entire, an inch or inch and half long; paler beneath. Stipules minute, awl-shaped, deciduous. Flowers large, handsome, sulphur-coloured, with a dark purple radiating spot at the base of each petal, solitary, erect, on long, simple, axillary stalks. Segments of the inner calyx nearly linear, half as long as the petals. Style hairy. Capsule the size of a filbert. Wool of the seeds of a dirty grey.—We have not heard of this plant in any English collection.

REDUVIA, in *Surgery*, a word used by some for a whitlow, and by others for a painful crack, or other disorder about the nails, either of the fingers or toes.

REDUX, in *Chemistry*. See REDUCT.

REDWAETH BAY, or *Traeth Coch*, in *Geography*, a bay on the N. coast of the island of Anglesey. N. lat. 53° 17'. W. long. 4° 25'.

REDWITZ, a town of Bavaria, in the bishopric of Bamberg; 4 miles N.N.W. of Kunitadt.

REDWITZ, a town of Germany, in the principality of Culmbach; 4 miles N. of Bayreuth.

REDWOOD RIVER, a river of America, which runs into the Wabash, N. lat. 40° 16'. W. long. 87° 5'.

REE, or RE, in *Commerce*. See REES.

REE, *Lough*, in *Geography*, an expansion of the waters of the river Shannon, in Ireland, between the county of Roscommon and the counties of Longford and Westmeath, reaching from Lanesborough nearly to Athlone, with several islands, and in some places three miles broad.

REED, in *Botany*. See ARUNDO.

The root of the *arundo donax* of Dioscorides, attracts any matter lodged in wounds, if powdered and applied to them with wine; or if it is taken fresh and reduced to powder with an onion, or mixed with honey. (Oribas de Morb. Cur. lib. iii. cap. 32.) It also removes pains arising from dislocation of limbs, and carries off pains in the hips. The green leaves cut and applied, are said to cure the erysipelas. Poor people boil the flowers in water or in beer, which they mix with honey, and drink, after being filtrated, to cure coughs, oppressions of the breast, and consumptions. The ancients made flutes and other musical instruments of the reed. James's Med. Dict.

REED, *Barr.* See SPARGANIUM.

REED, *Indian flowering*. See CANNA.

REED *Mace*. See TYPHA.

REED, in *Agriculture*, the name of an aquatic plant, infesting boggy lowlands or meadows on the sides of rivers.

The best method of destroying reeds, is by draining the land; for if the drains be cut deeper than their roots it will take away their nourishment, and, consequently, destroy them. Ashes, or foot, will likewise sometimes kill them; and so will ploughing up the land, and laying it in high ridges. They always indicate a deep good moist soil, as a bad one will not nourish or support them. There are many different sorts of reeds, but those of the more strong and tall kinds are often of much use in thatching the different sorts of farm buildings, where other better kinds of coverings are scarce, and these abundant. There is also a sort of reed found in Huntingdonshire, and some of the adjoining counties, that is very valuable for the purpose of laying plaster floors with. In other situations, reeds of the other kinds may be met with, that may be found useful for different purposes either of the farmer or in the arts. In such situations they may be cultivated with advantage as an article of profit: and it may often be more beneficial than to have them destroyed, especially where they are of a valuable nature, and where the land is of too moist and boggy a quality to be ever fully reclaimed and brought into either the state of good arable or meadow ground. Slips on the sides of large rivers or brooks are likewise, frequently, the most advantageously, conveniently, and profitably kept under reed crops, as the overflow of the waters prevent their being usefully managed in any other manner. There are other situations, as those about the borders of large ponds, lakes, and other waters, where they may be preserved with far greater propriety than having them destroyed, provided even that can be accomplished without difficulty, as not any thing more valuable can in general be raised in such places. They are, however, by no means to be continued wherever any better crop will grow and succeed.

REED is also a term applied to such straw of the wheat or rye kinds as has not been bruised by threshing or in any other way.

REED *Hedge*, in *Gardening*, that sort of hedge fence which is formed from reeds. They are a sort of temporary internal fences made with these dried materials which may be had cheap, and be expeditiously formed into hedges by the assistance

ance of post and railing, being of great utility for occasional use in gardens, to inclose particular internal spaces of ground, so as to afford shelter to certain seedling plants, both in nurseries and large kitchen gardens; and in some nurseries, to form places of shelter for many sorts of seedling trees and shrubs, &c., which being tender whilst young, require the shelter of a fence in winter to break off severe or cutting blasts two or three years, till they gradually gather strength and a greater degree of hardiness. They are also useful in training several sorts of wall-fruit-trees against, to form them for rows, or what are called trained trees; admitting of planting trees against each side of them, six, eight, or ten feet asunder. See NURSERY.

And in large open kitchen-gardens they are occasionally made use of to inclose the melonary, or place for raising early melons and cucumbers in, and often as cross internal fences, under which to form warm borders for the purpose of raising various early crops of esculents.

The proper sort of reeds for these fences are the dried stems of the common marsh reed, which grows in great plenty by river sides, and in lakes, and marshy places, furnishing a crop of stems annually fit to cut in autumn, when they should be bound in bundles, and stacked up, or housed, to remain for use.

These fences are sometimes erected in fixed ranges, and sometimes formed into moveable pannels. In the first mode, some stout posts should be placed six or eight feet asunder, and five or six high, and from post to post carry two or three ranges of flat thin railing, one range near the bottom, another near the top, and a third in the middle; against this railing, the reeds must be placed about two inches thick, having other railing fixed directly opposite; so that the reeds being all along between the double railing, the bottoms resting either upon a plate of wood, or let into the ground, but the former is preferable; and as soon as one pannel is formed, the railing should be nailed as close as possible, driving some long spike-nails through each double railing, or binding them with strong withy bands, or tar rope-yarn, but nailing is the best, in order to bring them as close as may be, to secure the reeds firmly in the proper position; the top should be cut even afterwards.

In the better method, a frame-work of railing should be prepared as above, each pannel six or eight feet long, and the reeds fixed therein as before directed; then, where they are intended to be placed, posts must be ranged six or eight feet distant to support the different pannels. Or sometimes the pannels may be placed inclining against the wall or other fence, in time of severe weather, when the borders are narrow. These sorts of fences are now however in much less use in gardening than formerly.

REED Ronds, in *Rural Economy*, a provincial word, signifying plots or beds of reed, or the swamps in which they grow.

REED, *Ezekiel's*. See *EZEKIEL'S REED*.

REED, *Calamus*, likewise denotes a Jewish measure, otherwise called canna.

REED, in the *Manufactory of Tapestry*. See *TAPESTRY*.

REED Sparrow, in *Ornithology*. See *EMERIZA Schoeniculus*.

REED Point, in *Geography*, a cape on the W. coast of the island of Antigua. N. lat. $17^{\circ} 12'$. W. long $61^{\circ} 36'$.

REEDHAM. See *REEPHAM*.

REEDS, in a *Fire-ship*, are made up in small bundles of about twelve inches in circumference, cut even at both ends, and tied each with two bands. There are two kinds of them; the long, which are four feet; and the short, which are two feet five inches in length. Some of them are singly

dipped, *i. e.* at one end, the rest are dipped at both ends, in a kettle of melted composition. After being immersed about seven or eight inches in this preparation, and then drained, they are sprinkled over with pulverized sulphur upon a tanned hide. See *FIRE-SHIP*.

REEDSBOROUGH, in *Geography*. See *READSBOROUGH*.

REEDSTOWN. See *STRONG*.

REEDY CREEK, a river of New Jersey, which runs into the Atlantic, N. lat. $39^{\circ} 55'$. W. long. $74^{\circ} 16'$.

REEDY Island, an island of America, in the Delaware river, 50 miles below Philadelphia, and 20 miles from Bombay Hook, about three miles long and not more than one-fourth of a mile wide. This island was formerly banked in, but is now under cultivation, and overflowed in high tides. It is the rendezvous of outward-bound ships in autumn and spring, waiting for a fair wind. Here is a secure harbour at Port Penn, where piers have been erected by the state of Pennsylvania. On each side of the island is a channel; but vessels, especially of the larger kind, choose to keep the eastern side.

REEDY River. See *SALUDA*.

REEDY River Shoal, a post-town of America, in Greenfield county, South Carolina.

REEF (*reef*, Dutch, in *Navigation*, denotes a certain portion of a sail, comprehended between the top or bottom, and a row of eyelet-holes parallel to it. The intention of the reef is to reduce the surface of the sail in proportion to the increase of the wind; for which purpose there are several reefs parallel to each other in the superior sails, by which they may be still farther diminished, in order to correspond with the several degrees of the gale. The top-sails of ships are usually furnished with four reefs, parallel to the yard; and there are always three or four reefs parallel to the foot of those main-sails and fore-sails which are extended upon booms; a circumstance common to many of the small vessels. Falconer.

A *bag-reef* is the fourth, or lower, reef of a top-sail. A *balance-reef* crosses boom-main-sails diagonally, from the nock to the end of the upper reef-band on the after-larch. This is used to contract the sails in a storm.

REEF also denotes a chain of rocks, lying near the surface of the water.

REEF-Band, in *Sea Language*, a piece of canvas, sewed across the sail, to strengthen it in the place where the eyelet-holes of the reefs are formed.

REEF-Hanks, short pieces of log-line or other small line, fastened at certain distances to form the reefs of boom-sails.

REEF-Tackle, is a rope which passes from the deck to a block at the top-mast head, and thence to another block at the top-sail-yard-arm, where it communicates with another rope, called its *pendant*, that runs downwards through a hole in the yard, and is afterwards attached to a cringle, a little below the lowest reef. It is used to pull the skirts of the reefs close up to the extremities of the top-sail yards, in order to lighten the sail, the weight of which would otherwise render it very difficult to perform this operation. Falconer.

REEF Island, in *Geography*, a small island in the East Indian sea, about 50 miles from the W. coast of Sumatra. S. lat. 4° . E. long. $101^{\circ} 3'$.—Also, a small island in the East Indian sea, near the N. coast of the island of Celebes. N. lat. $0^{\circ} 8'$. E. long. $122^{\circ} 48'$.

REEFING, in *Sea Language*, the operation of reducing a sail, by taking in one or more of the reefs, which is performed by lines, points, or knittles. The top-sails are always

always, and the courfes generally, reefed with points, which are flat braided pieces of cordage, whose lengths are nearly double the circumference of the yard. Thefe, being inferted in the eyelet-holes, are fixed in the fail by means of two knots in the middle, one of which is before, and the other behind the reef-band. In order to reef the top-fails with greater facility and expedition, they are lowered down, and made to fliver in the wind, which considerably relaxes their tenfion. The extremities of the reef are then drawn up to the yard-arms by an affembly of pulleys communicating with the deck, termed the *reef-tackle*; and they are fe curely faltened to the yard-arms by fmall cords, called *earings*. The fpace of fail, comprehended in the reef, is then laid fmoothly over the yard, in feveral folds or doubles; and the whole is completed by tying the points above the yard, fo as to bind the reef clofe up to it. The courfes of large fhips are reefed either with points or fmall cords, which are thence called *reef-lines*. In the latter cafe, the line is paffed fpirally through the eyelet-holes of the reef, and ever the head of the fail alternately, and afterwards ftained as tight as poffible. It muft be obferved, however, that the reef-line is fometimes paffed round the yard, and fometimes only round the head of the fail; and each of thefe methods has its advocates. But if it fhould appear effential to prevent the friftion by which a fail is galled between the line and the yard, and as the rope-bands are fufficient to fuffain the effort of the fail, it is better to pafs the line only round the fail, provided that the turns are inferted through the roband legs; a circumftance carefully praftifed by every fkilful failor. The fame reafon may be alleged in favour of tying the points of the courfes in the fame manner; *i. e.* the after-end of the point fhould be thruft forward between the head of the fail and the yard; and the fore-end of the faild point fhould come aft over the head of the fail and alfo under the yard; and thus croffed over the head of the fail, the point fhould be extended, and the two ends brought over the yard; and tied on the upper fide of it as ftraight as poffible.

When a fail is reefed at the bottom, it is done by knittles, which, being thruft through the eyelet-holes of it, are tied firmly about the fpace of canvas of which the reef is composed, and knotted on the lower fide of the bolt-rope. Thefe knittles are accordingly removed as foon as the reef is let out. Falconer.

REEK, in *Rural Economy*, a term provincially ufed for ftack. See *STACK* and *RICK*.

REEK-*Stavel*, a term applied to a frame of wood placed on ftone, on which the mow or ftack is raifed. It is fometimes written *Reek Staffold*.

REEL, in the *Manufactories*, a machine ferving for the office of reeling.

There are various kinds of reels; fome very fimple, others very complex. Of the former kinds, thofe moft in ufe are,

1. A little reel, held in the hand, confifting of three pieces of wood, the biggeft and longeft whereof (which does not exceed a foot and a half in length, and a quarter of an inch in diameter,) is traverfed by two other pieces difpofed different ways.

2. The common reel, or windlace, which turns upon a pivot, and has four flights, traverfed by long pins, or fticks, on which the ftain to be reeled is put; and which are drawn clofer or opened wider, according to the ftain.

Other reels ufed in particular arts, are explained under their particular articles; as the reel ufed in milling of filk, under the article *MILLING*; and that in the reeling or winding of filks, under the article of *SILK*, &c.

REELS, to reel ropes on from a fix-thread ratline to a two-inch rope, have four ribs fixed at each end in a flat circular piece of wood; and round the edges are blades, or handles, to turn them: one of the circular pieces is called the *head*, and is made to fide off for taking the coil away. They turn on an iron fpindle, and are from ten to thirty-fix inches long, and from twelve to eighteen inches diameter. The *Bench-reel* ufed by fail-makers is fimilar to a fpinning-wheel, and is ufed to expedite winding the twine from the ftains to the twine-reel. *Log-reels* have feveral ribs fixed in a circular piece of board at each end, and turn or run upon a fpindle, having a handle at one end. (See *LOG*.) *Twine-reels*, ufed by fail-makers, are fhort cylindrical pieces of wood, hollowed in the middle to receive the twine, with a hole through the middle for the fpindle. Thofe ufed by rope-makers have four oak bars, about eighteen inches long, framed together at the ends on a wooden fpindle; one of the bars fides, for the convenience of taking off the twine. The *Yarn-reel* confifts of a circular board faltened horizontally on the middle of a piece of oak four inches fquare, and fixteen long, with a hole through its middle to receive a bolt, on which it turns as its axis, and is ufed to wind fpanyarn off the coil. The *Hand-reel* is a narrow board, with three or four holes at each end, in which pegs are fixed for reeling marline and other lines.

REELFOOT, in *Geography*, a fmall navigable river of America, in Tennessee, which difcharges itfelf into the river Miffiffippi, about 35 miles S. of the Ohio. It is 30 yards wide feven miles from its mouth. One of its branches rifes on the borders of Kentucky.

REELING, in the *Manufactories*, the winding of thread, filk, cotton, or the like, into a ftain, or upon a bottom, to prevent its entangling.

It is alfo ufed for the charging or difcharging of bobbins, or quills, to ufe them in the manufacture of different ftuffs, as thread, filk, cotton, &c.

Reeling is performed different ways, and by different engines.

REEM, in *Zoology*. See *RHINOCEROS Unicornis*.

REEMING, a term ufed by caulkers for opening the feams of the planks with reeming-irons, that the oakum may be more readily admitted. To make any hole larger is alfo termed reeming.

REEMING-Irons, are the largeft irons ufed by caulkers in opening the feams.

REEMSTOWN, or REAMSTOWN, in *Geography*, a fmall poft-town of America, in Lancafter county, Pennsylvania, fituated on a ftream which runs into Calico creek, a water of Conefstoga, which falls into the Sufquehannah; 26 miles N.E. of Lancafter.

REEN, a river of Norway, in the province of Drontheim, which runs into the Glomme; 20 miles N. of Opfal.

REEN *Moffa*, a name ufed by fome for the mountain coralloides, or rein-deer mofs.

REENBERG, THEOCARUS, in *Biography*, a celebrated Danifh poet, was born at Viborg in 1656, where he was educated. In 1680 he fet out on his travels into foreign countries, after having undergone an examination by the theological faculty, and he returned to Denmark in 1682. In 1703 he was appointed fourth judge in Jutland. In 1730 he became counfellor of juftice, and he died in 1742. His poetical works were published at Copenhagen in 1769, by his grandfon Tielmann, with a preface by Kofod Anker, and annotations by Luxdorph. Gen. Biog.

REENSKLOSSER, in *Geography*, a town of Norway; 12 miles N.N.W. of Drontheim.

RE-ENTER-

RE-ENTERING ANGLE, in *Fortification*. See ANGLE, and CONSTRUCTION, according to *M. Vauban's first method*.

RE-ENTRY, in *Law*, the refusing or retaking that possession which any one had lately forgone.

As, if I make a lease of land or tenement, I do thereby forego the possession: and if I condition with the lessee, that for non-payment of rent at the day, it shall be lawful for me to re-enter; this is as much as if I conditioned to take again the lands, &c. into my own hands, and to recover the possession by my own act, without the assistance of judge or other process. But words in a deed give no re-entry, if a clause of re-entry be not added. (*Wood's Inst.* 140.) All persons who would re-enter on their tenants for non-payment of rent, are to make a demand of the rent; and, to prevent the re-entry, tenants are to tender their rent, &c. (1 *Inst.* 201.) If there is a lease for years, rendering rent, with condition, that if the lessee assigns his term, the lessor may re-enter; and the lessee assigns, and the lessor receiveth the rent of the assignee, not knowing or hearing of the assignment, he may re-enter, notwithstanding the acceptance of the rent. (3 *Rep.* 65. *Cro. Eliz.* 553.) See RENT. A feoffment may be made upon condition, that if the feoffor pay to the feoffee, &c. a certain sum of money at a day to come, then the feoffor to re-enter, &c. *Litt.* § 322. See ENTRY and USE.

REEPHAM, in *Geography*. See REPHAM.

REER COUNTY. See RIRE.

REERSOE, in *Geography*, a small island of Denmark, in the Great Belt, near the coast of Zealand. N. lat. 55° 32'. E. long. 11° 7'.

REES, REIS, or *Reas*, in *Commerce*, monies of account in Portugal, 1000 of which make a milreis or milree. In the notation of accounts, the milrees are separated from the rees by a crossed cypher, called "Cifraon," and the milrees from the millions by a colon; thus Rs. 2 : 700 ⊕ 500, means 2700 mil. and 500 rees. The crusado of exchange, or old crusado, is 400 rees; the new crusado, 480 rees; the testoon, 100; the vintin or vintem, 20 rees. Thus the milree is 2½ old crusados, 2⅓ new ditto, 10 testoons, or 50 vintins. The gold pieces, coined before 1722, are now 20 *per cent.* higher than their original value; so that the old dobras, coined at 20,000 rees, are worth 24,000; the lisbonnoies or moldores, coined at 4000 rees, are worth 4800; and the halves and quarters in proportion: but few of these coins are now in circulation. The gold coins, struck since 1722, are the dobra of 12,800 rees; the meia dobra, Joaneffe, or Portugal piece of 6400 rees; the half Joaneffe, of 3200; the dezefeis testoons, of 1600; the quatingo, of 1200; the oito testoons, of 800; the old crusado, of 400, now very scarce; and the new crusado, of 480 rees. The silver coins are new crusados, of 480 rees; halves, quarters, and eighths, or pieces of 240, 120, and 60 rees; testoons of 100, and halves of 50; and vintins of 20 rees. There are also copper pieces of 10, 5, 3, and 1½ rees. The pieces coined in Brazil, called patacas, of 600 and 640 rees, are current only in that country, and their intrinsic value is 10 *per cent.* less than that of the Portugal coins. There is, besides, a gold milree, struck for the Portuguese possessions in Africa, and also a silver coin, of the value of 12 macutas, or 600 rees; the macuta being a money of account, worth 50 rees. The Spanish patacas, or dollar, are reckoned at Lisbon at 830 rees, more or less.

Portuguese gold coins are 22 carats (the mark fine being 24 carats), wrought gold is 20½ carats, and gold dust from 21½ to 22 carats fine. The fineness of silver is expressed in dinheiros and grains, the mark fine being 12 dinheiros, and the dinheiro subdivided into 24 grains. Silver coins are

10 dinheiros 19 grains fine, and wrought silver 10½ fine. The rate of coinage of gold and silver coins is as follows: 8 dobras of 12,800 rees, 16 Joaneffes of 6400 rees, 32 half Joaneffes of 3200 rees, 64 dezefeis testoons, 128 oito testoons, or 256 old crusados, are to weigh a Portuguese mark of gold, 22 carats fine. Hence (the mark being 3542½ English grains) the dobra contains 442½ grains; the piece of 6400 rees 221½ grains of English standard gold, and the other pieces in proportion. These coins, moreover, are not, in general, exactly 22 carats fine; but there is a remedy which amounts from ⅓ to ⅓ of a carat; and the new crusados are found to be only 21½ carats fine. The silver coin is 10 din. 19 gr. as above; and the mark is coined into 13½ new crusados; hence the new crusado weighs 345½ Portuguese grains, or 265½ English grains; halves, quarters, and eighths, in proportion. It, therefore, contains 258½ grains of English standard silver. The gold piece of 6400 rees is worth 35s. 11d. sterling; and the old crusado, 2s. 3d.; and thus the milree, valued in gold, is worth 67½d. sterling. The new silver crusado is worth about 2s. 9d. sterling; and, therefore, the milree, valued in silver, is worth 68½d. sterling. Gold is to silver as 16 to 1.

At Bombay each quarter of a rupee is divided into 100 rees. See RUPEE.

REES, in *Geography*, a town of the duchy of Cleves; 8 miles E. of Cleves. N. lat. 51° 47'. E. long. 6° 20'.

REES ul Ain, or *Refaina*, a town of Asiatic Turkey, in the province of Diarbekir; 80 miles S. of Diarbekir.

REETZ, a town of the New Mark of Brandenburg; 50 miles N.E. of Custrin. N. lat. 53° 18'. E. long. 15° 56'.

REEVE, in *Ornithology*, the name of a bird which is the female of the *avis pugnax*; the male of which, from the long feathers round his neck, is called the *ruff*. See TRINGA *Pugnax*.

REEVE of a Church, is the guardian of it, or the churchwarden.

So *shire-reef* is the sheriff, or guardian of a county; and *port-reeve*, the warden of a port or haven.

REEVE-LAND. See REVELAND.

REEVING, in the *Sea Language*, is the putting a rope through any hole, as the channel of a block, &c. Hence, to pull a rope out of a block, is called *unreeving*.

RE-EXCHANGE, in *Commerce*, a second payment of the price of exchange, or rather the price of a new exchange, due upon a bill of exchange that comes to be protested; and to be refunded the bearer, by the drawer or indorser. See EXCHANGE.

The occasion of re-exchange is, when the bearer of a bill of exchange, after protesting it, for want either of acceptance, or of payment, borrows money on his own promise, bond, or the like; or draws a bill of exchange in the place where the payment was to be made, on the person who furnished the first for which he pays a second exchange; which, being added to the first already paid, the drawer of the first bill is answerable for two exchanges, properly called *exchange* and *re-exchange*.

The bearer of a protested bill has a right to recover both the one and the other on the drawer. Yet the simple protestation which the bearer makes in the act of protest, that he will take up a like sum at re-exchange, for want of his bill being accepted or paid, is not sufficient to entitle him to demand the reimbursement of his re-exchange, unless he make it appear, that he has actually taken up money in the place on which the bill was drawn.

Otherwise the re-exchange will only amount to the restitution of the first exchange, with interest, the expences of protesting, and those of the journey, if there have been any.

If a bill of exchange, payable to the bearer or order, come to be protested, the re-exchange is only due upon the drawer for the place where the remittance was made, not for those places where it may have been negotiated; at least the drawer has a right to be refunded his re-exchange for those places by the indorser.

Indeed, the re-exchange is due from the drawer upon all places where a power of negotiation is given by the bill; and upon all others, if the power of negotiating be indefinite.

Lastly, the interest of the re-exchange, of the expences of the protest, and the journey, are only due from the day of the demand.

It is supposed to be the Gibelins driven out of Italy by the faction of the Guelphs, and sheltered at Amsterdamm, who first established the custom of re-exchange, on pretence of the interests, damages, and expences they underwent, when the bills given them for the effects they had been obliged to abandon, were not accepted, but came to be protested.

RE-EXTENT, in *Law*, a second extent made upon lands or tenements, on complaint that the former extent was partially made. See EXTENT.

REFAH, in *Geography*, a town of Egypt, on the coast of the Mediterranean, anciently called "Raphia," (which see); 18 miles N.E. of El Arish.

REFECTION, REFECTIO, among *Monks* and *Ecclesiastics*, a spare meal or repast, just sufficing for the support of life.

REFECTION is also used, in *Ancient Authors*, for a duty or service incumbent on any person to provide meals for ecclesiastics, or even for princes.

REFECTORY, or REFECTUARY, *Refectorium*, a spacious hall in convents, and other communities, where the monks, nuns, &c. take their refectious or meals in common.

The refectory of the Benedictines of St. George at Venice, designed by Palladio, is one of the finest in the world. Daviler.

REFERENCE, in *Writing*, &c. a mark relative to another similar one in the margin, or at the bottom of the page, where something, omitted in the text, is added; and which is to be inserted either in reading or copying. A copyist must be very expert at taking references.

References are also used in books, where things being but imperfectly handled, the reader is directed to some other part or place where they are more amply explained.

Dictionaries are full of references, denoted by *see* or *vide*.

By means of these references the dictionary writer settles a correspondence between the several parts of his work, and may give his dictionary most of the advantages of a continued treatise.

Indices or tables are only references to the several parts of the work where the several matters are handled.

REFERENCE, in *Law*, denotes the sending of any matter by the court of chancery to a master; and by the courts at law to a prothonotary, or secondary, to examine and report to the court. (2 Lil. Abr. 432.) If a matter in difference be referred to the secondary, and one of the parties will not attend at the time appointed, after notice given, to hear the business referred; the other party may proceed in the reference alone, and get the secondary to make his report without hearing of the party not attending. (2 Lil. 342.)

If a question of mere law arises in the course of a cause in chancery, as whether, by the words of a will, an estate for life or in tail is created, or whether a future interest devised by a testator shall operate as a remainder on an executory devise; it is the practice of that court to refer it to the opinion of the judges of the court of king's bench, or common

pleas, upon a case stated for that purpose, in which all the material facts are admitted, and the point of law is submitted to their decision; who thereupon have it solemnly argued by counsel on both sides, and certify their opinion to the chancellor; and on such a certificate the decree is usually founded. It seems that the master of the rolls, sitting for the chancellor, may make such reference; but not when sitting at the rolls. 2 Bro. C. C. 88.

The court of exchequer is both a court of law and of equity: therefore, if a question of mere law arises in the course of the exercise of its equitable jurisdiction, the barons will decide upon it in that suit, without referring it to another jurisdiction. Bl. Comm. iii.

REFERENDARY, REFERENDARIES, in *Ancient Customs*, an officer who exhibited the petitions of the people to the king, and acquainted the judges with his commands.

An officer of this kind, Spelman observes, we had in England, in the time of the Saxons. The like office was afterwards discharged by others, called masters of requests.

REFINING, in *Metallurgy* and *Affaying*. In the former it signifies the means of obtaining metals from their ores, and from any other impurities, natural or artificial; for which see the metals under their respective heads. In the latter it is employed for ascertaining the quantity of the noble metals in the different alloys: for which see CUPEL; where the methods of refining in the furnace are fully treated. And for the humid process called *parting*, see GOLD.

It may be proper here to observe, that although the process of parting by nitric acid is still practised, we are inclined to recommend the method proposed by Bergmann, which consists in dissolving the alloy of gold and silver in nitro-muriatic acid. The silver falls to the bottom in the state of muriate of silver, and the gold is precipitated by the green sulphate of iron. The gold, by this means, is obtained perfectly pure, which is seldom the case in the process of parting. The trouble of telling to know what silver to add to the alloy, to make the gold equal to one-fourth of the silver, will be saved, and, with heat, the nitro-muriatic acid dissolves the gold quite as soon as the silver is dissolved in the common method. The muriate of silver, which is easily separated by washing, may be readily reduced by heating it with soda in an iron crucible. The soda combines with the muriatic acid, and is sublimed in white fumes.

REFINING of *Sugar*. This operation is begun by several strong lixiviums or leys of lime-water and eggs, shells and all, mixed and beaten together.

The first refining is performed in the Caribbees, and other places, where the sugar-canes are cultivated; and only serves to make the brown or coarse sugars.

When these are imported into Europe, the sugar-bakers take them up, and refine them farther, by a second operation, or rather a repetition of the first.

To render the sugar very fine, fit for confections, &c. they give it a third refining; in which they only use the whites of eggs and their shells beaten together, and thrown into the melted sugar; which is called *clarifying the sugar*. See SUGAR.

REFINING of *Salt-petre*. The salt being put into an earthen or iron vessel, as much spring-water is poured on it as suffices to dissolve it. The vessel is then put over a gentle fire; and as soon as the water begins to boil, alum powder is thrown into it: the proportion is, one pound of alum to one hundred and twenty-eight pounds of salt-petre; and a little vinegar is added. As it boils, the scum is to be taken off; and it is to be evaporated till a pellicle appears on it, and then set to shoot.

For the refining of other matters, as camphor, cinnabar, sulphur, salt, borax, &c. see CAMPHOR, CINNABAR, SULPHUR, SALT, &c.

REFIRTH VOE, in *Geography*, a bay on the E. coast of the island of Yell. N. lat. $60^{\circ} 58'$. W. long. $1^{\circ} 25'$.

REFITTING, in *Sea Language*, denotes the repairing of any damages which a ship may have sustained in her sails and rigging, by battle or tempestuous weather.

REFLECTED RAY. See RAY.

REFLECTED Vision. See REFLEX and VISION.

REFLECTING, or REFLECTIVE Dial, is a sort of dial, which shews the hour by means of a thin piece of looking-glass plate, duly placed to cast the sun's rays to the top of a ceiling, on which the hour-lines are drawn.

REFLECTING Microscope. See MICROSCOPE.

REFLECTING Level. See LEVEL.

REFLECTING Telescope. See TELESCOPE.

REFLECTION, or REFLEXION, in *Mechanics*, the return, or regressive motion of a moveable, occasioned by the resistance of a body, which hindered its pursuing its former direction.

It is controverted whether there be any moment's rest or interval between the incidence and the reflection. For the affirmative stand the Peripatetics, and all who conceive the reflected motion to be different from the incident one of the same body. The motion of incidence, according to these authors, is wholly lost, and destroyed, by the resistance of the obstacle struck against; and the moveable is thus rendered absolutely quiescent in the point of contact, till a new motion of reflection is produced in it, from a contrary cause.

The Cartesians assert the negative; absolutely denying any rest at all between the incidence and reflection: urging, that if the motion were once destroyed, though but for a moment, there would be nothing to excite it again; but the body would persevere in that new state, as much as if it had been at rest a thousand years.

Accordingly Rohault, and others, define reflection to be no other than a change of determination; or a continuation of the former motion in a new direction.

As, say they, a pendulum, when arrived at its greatest sweep, does not stop; so a hard body, by striking on another hard one, does not rest, but pursues its motion the contrary way, according to the established law of nature; and this from the immediate influence or impulse of the cause that first moved it. But this doctrine is now generally set aside.

Reflection is conceived, by the latest and best authors, as a motion peculiar to elastic bodies, whereby, after striking on others which they cannot remove, they recede, or turn back by their elastic power.

On this principle, it is asserted, that there may be, and is, a period of rest between the incidence and the reflection; since the reflected motion is not a continuation of the other, but a new motion, arising from a new cause or principle, viz. the power of elasticity.

It is one of the great laws of reflection, that the angle a reflected body makes with the plane of a reflecting obstacle, is equal to that in which it struck on that obstacle. For the several laws of motion observed in the reflections of bodies, see PERCUSSION.

REFLECTION of the rays of light, in *Optics*, is a motion of the rays, by which, after impinging on the solid parts of bodies, or rather, after a very near approach to them, they recede, or are driven from them.

When rays of light arrive at a surface, which is the boundary of two mediums not homogeneous, they continue

their progress without deviating from those planes in which their former paths lay, and which are perpendicular to the surface of the mediums, but they no longer retain the same direction, a part of them, and sometimes nearly the whole, being reflected back from the surface, while the remaining part is transmitted and refracted, or bent. No instance occurs of the abrupt change of the density of a medium, without a partial reflection of the light passing either into the denser, or into the rarer medium; and the more obliquely the light falls on the surface, the greater, in general, is the reflected portion. No body is so black as to reflect no light at all, and to be perfectly invisible in a strong light; although at the surface separating two very rare bodies, as two kinds of gas, the reflection is too faint to be perceptible; but in this case the separation is seldom perfectly abrupt. The quantity of light reflected, when other circumstances are equal, appears to be always greatest when the difference of the optical or refractive density of the two substances is the greatest. Thus, the reflection from the common surface of glass and water is much weaker than from a surface of glass exposed to the air. Metals, in general, reflect a great proportion of the light falling on them; and even the reflection from the common surface of glass and mercury appears to be but little weaker than the reflection from the surface of mercury immediately exposed to the air, so that the optical density of the metals must be exceedingly great. It appears, also, that a portion of the light falling on a reflecting surface, is always transmitted to a certain depth, notwithstanding the apparent opacity of any large masses of the substance. Thus, if we cover a small hole of a window-shutter with the thinnest leaf-gold, we shall find that it transmits a greenish light, which must have passed the reflecting surface, but which, if the gold had been but one ten-thousandth of an inch in thickness, would have been wholly interrupted, and probably in the same manner as by passing through 700 feet of water. See LIGHT and REFRACTION.

The reflection of the rays of light from the surfaces of bodies, is the means by which bodies become visible.

And the disposition of bodies to reflect this or that kind of rays most copiously, is the cause of their being of this or that colour.

The reflection of light from the surfaces of mirrors, makes the subject of *catoptrics*; which see. See also MIRROR.

The reflection of light, sir Isaac Newton has shewn, is not effected by the rays striking on the very parts of the bodies; but by some power of the body equally diffused throughout its whole surface, by which it acts upon the ray, attracting or impelling it without any immediate contact.

This power he shews to be the same, by which, in other circumstances, the rays are refracted; and by which they are at first emitted from the lucid body. See REFRACTION.

The arguments he produces to prove this are as follow: 1. Because the surfaces of polished glasses, which to the eye appear smooth, are yet, in reality, very rugged and uneven (polishing being nothing but the grating, scratching, and breaking off the coarser protuberances, by means of sand, glass, putty, tripoli). If the rays of light, therefore, were reflected by striking on the solid parts of the glass, the reflections would never be so accurate as we find they are, but the rays would even be as much scattered by the most polished glass, as by the roughest. It remains, therefore, a problem how glass, polished by fretting substances, can reflect light so regularly as it does; which problem is scarcely otherwise to be solved, than by saying, that the reflection of a ray is effected, not by a single point of the reflecting

REFLECTION.

reflecting body, but by some power of the whole body, evenly diffused all over its surface, and by which it acts on a ray without immediate contact; for that the parts of bodies do act upon light at a distance, is already shewn under the articles *REFLECTION* and *LIGHT*.

2. If the colours, separated by a prism placed at the entrance of a beam of light into a darkened room, be successively cast on a second prism placed at a greater distance from the former, in such manner as that they all fall alike, or with an equal obliquity, upon it; the second prism may be so inclined to the incident rays, that those which are of a blue colour shall be all reflected by it; and yet those of a red colour pretty copiously transmitted. Now, if the reflection were caused by the parts of the air or glass, we would ask, why, at the same obliquity of incidence, the blue should wholly impinge on those parts so as to be all reflected; and yet, the red find pores enough to be, in a great measure, transmitted.

3. Where two glasses touch one another, there is no sensible reflection; and yet we see no reason why the rays should not impinge on the parts of the glass, as much when contiguous to other glass, as when contiguous to air.

4. When the top of a water bubble, by the continual subsiding and exhaling of the water, grows very thin, there is such a little, and almost insensible quantity of light reflected from it, that it appears intensely black; whereas round about that black spot, where the water is thicker, the reflection is so strong, as to make the water seem very white. Nor is it only at the least thickness of thin plates or bubbles, that there is no manifest reflection, but at many other thicknesses, gradually greater and greater. For, in one of our author's observations, the rays of the same colour were, by turns, transmitted at one thickness, and reflected at another thickness, for an intermediate number of successions: and yet, in the superficies of the thinned body, where it is of one thickness, there are as many other parts for rays to impinge on, as where it is of any other thickness.

5. If the red and blue rays, separated by a prism, fall successively on a thin plate of any pellucid matter, whose thickness increases in continual proportion, (such as a plate of air between two glasses, the one plane, and the other a little convex,) the same plate will, in the same part, reflect all the rays of one colour, and transmit all those of the other; but, in different parts, will reflect the rays of one and the same colour at one thickness, and transmit them at another; and thus alternately, and *in infinitum*. Now, it can never be imagined that at one place the rays, which, for instance, exhibit a blue colour, should happen to strike on the solid parts, and those which exhibit a red, to hit on the void parts of the body; and at another place, where the body is either a little thicker, or a little thinner, that, on the contrary, the blue should hit on the pores, and the red upon the solid parts.

6. In the passage of light out of glass into air, there is a reflection as strong as in its passage out of air into glass, or rather a little stronger, and by many degrees stronger than in its passage out of glass into water. Now, it seems improbable, that air should have more reflecting parts than water or glass: but if that should be supposed, yet it will avail nothing; for the reflection is as strong, or stronger, when the air is drawn from the glass by the air-pump, as when it is adjacent to it. If any should here object, on Descartes's hypothesis, that, though the air be drawn away, there is a subtle matter remaining to supply its place, which, being of a denser kind, is better fitted for the reflection of light than any other body; besides that we have elsewhere shewn such subtle matter to be fictitious, and that, suppos-

ing its existence, and its reflecting power, no light could ever have been propagated, but must have been all reflected back to the lucid body, immediately after it was first emitted, the following experiment does evidently convict it of fallacy.

7. If light, in its passage out of glass into air, strike more obliquely than at an angle of forty or forty-one degrees, it is then wholly reflected: if less obliquely, it is in great measure transmitted. Now, it is not to be imagined, that light at one degree of obliquity should meet with pores enough in the air to transmit the greater part of it, and at another degree should meet with nothing but parts to reflect it wholly; especially considering, that, in its passage out of air into glass, how oblique soever be its incidence, it finds pores enough in the glass to transmit a great part of it. If any suppose, that it is not reflected by the air, but by the utmost superficial parts of the glass, there is still the same difficulty: besides, that such a supposition is unintelligible, and will also appear to be false, by applying water behind some part of the glass, instead of air; for so in a convenient obliquity of the rays, suppose of forty-five or forty-six degrees, at which they are all reflected, where the air is adjacent to the glass, they shall be in great measure transmitted where the water is adjacent to it; which argues, that their reflection or transmission depends on the constitution of the air and water behind the glass, and not on the striking of the rays upon the parts of the glass, the rays not being reflected until they have reached the last part of the surface, and have begun to go out. For if, in going out, they fall upon a surface of oil and water, they proceed, the attraction of the glass being balanced by an equal force the contrary way, and prevented from having its effect by the attraction of the liquor adhering to it: but if the rays, in passing out of this last surface, fall into a vacuum, which has no attraction, or into air, which has but little, not enough to counterbalance the effect of the glass in this case, the attraction of the glass draws them back, and reflects them.

This will appear still more evident by laying two glass prisms, or the object-glasses of two telescopes, the one plane, and the other a little convex, upon each other, so as they may neither touch, nor yet be too far apart; for that light which falls on the hinder surface of the first glass, where the glasses are not above $\frac{1}{1000000}$ th part of an inch apart, will be transmitted through the surface, and through the air or vacuum between the glasses, and will pass into the second glass; but if the second glass be taken away, then the light passing out of the second surface of the first glass into the air or vacuum, will not proceed, but will return into the first glass, and be reflected.

Whence it follows, that the rays are drawn back again by some force in the first glass, there being nothing else to occasion their return. And hence too it follows, that the reflection is not effected by means of any subtle matter contiguous to the hinder surface, according to the principles of Descartes; since that matter ought to reflect them when the glasses were nearly contiguous, as well as when the second glass is quite removed.

Lastly, if it be asked, how some of the rays come to be reflected, and others transmitted; and why they are not all alike reflected, supposing the reflection owing to the action of the whole surface? the same great author shews, that there are, both in the rays of light, and in the bodies themselves, certain vibrations (or some such property) impressed on the rays, by the action either of the luminary that emits them, or of the bodies that reflect them; by means of which it happens that those rays, in that part of their vibration

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which conspires with the motion of the parts of the body, enter the body, are refracted and transmitted; but those in a contrary part of their vibration are reflected.

Add, that every ray of light, in its passage through any refracting surface, is put into a certain transient constitution or state, which, in the progress of the ray, returns at equal intervals, and disposes the ray, at each return, to be easily transmitted through the next refracting surface; and between each return, to be easily reflected by it.

These alternate dispositions, which sir Isaac Newton calls *fits of easy reflection*, and of *easy transmission*, he accounts for by supposing, that they are occasioned by the vibrations of a subtle fluid, in which the ray passes, which happening to move faster than the rays, when a ray is in that part of the vibration which conspires with its motion, it passes through; but when in the contrary part of the vibration, it is beat back again: whence every ray is successively disposed to be easily reflected, or easily transmitted, by every vibration which overtakes it.

He also thought that these vibrations might be excited by the mutual action and re-action of light, of bodies and of this medium, at the instant of reflection or refraction; so that, in fact, he supposes two causes of this disposition to be reflected or transmitted, when rays of light arrive at any new surface. One of them is the regular vibration of the ethereal medium, affecting them through the whole of their progress from the luminous body; and the other the tremulous motion, or irregular vibration of the same medium at the surfaces of bodies, occasioned by the action and re-action between light and them: for this last cause can hardly be supposed to affect the whole ethereal medium equally, and produce the regular returns of these fits in every ray.

M. Boscovich supposes with Newton, that the fits of reflection or transmission affect the rays themselves, in the whole of their passage from the luminous body, but that they arise from an alteration in their form, by means of the elasticity of their component parts, having been originally driven from the luminous body by a force which acted more strongly on the hinder parts than on the rest of the mass, and thereby put them into a vibratory motion. He also supposes, that the intervals of the fits of easy reflection and transmission may be different in different rays, on the three following accounts. 1. The rays that are differently refrangible have different velocities, at least after refraction; so that, though the fits should return at equal intervals, it will affect different rays in different parts of their progress. 2. The unequal action between the points that compose the same particle of light may make a difference in their oscillations, at the time of changing their medium. And lastly, rays coming in different inclinations to the new surface, the internal motions of these points will be in different directions with respect to the surface, and consequently the whole mass of the medium will act upon all the points differently. Boscov. *Theoria*, p. 232.

Upon the whole, says Dr. Priestley, is it not more probable that the rays of light are transmitted from the sun, with an uniform disposition to be reflected or refracted, according to the circumstances of the bodies on which they impinge; and that the transmission of some of the rays under the same circumstances, apparently, with others that are reflected, is owing to the minute vibrations of the small parts of the surfaces of the mediums through which the rays pass; vibrations that are independent of action and re-action between the bodies and the particles of light at the time of their impinging, though probably excited by the action of preceding rays. As to the transmission or reflection of certain kinds of light only, producing colours in thin plates,

the cause may be this; *viz.* that every particle of the medium has a great number of equal alternate intervals of attraction and repulsion, relatively to the particles of light; but that these intervals are of different magnitudes, according as the particles of light are of different colours. Now if the thickness of any transparent medium in which the particles of matter are uniformly placed is such, that the attracting intervals of the extreme particles, as well as the repelling intervals, coincide with one another, *i. e.* attracting with attracting, and repelling with repelling, in regard to any one kind of rays, *e. g.* the red; by the united force of these extremes, (all the intermediate particles of the medium mutually destroying each other's effects,) these rays will be reflected. But where the plate is of an intermediate thickness between this and the next thickness, where the attracting intervals coincide, attracting with attracting, and repelling with repelling, the attracting intervals will coincide with the repelling ones, and the repelling ones with the attracting ones, and these mutually destroying one another's effects, these rays will pass on freely, and be transmitted. But as the intervals of attraction and repulsion are different for differently coloured rays, the thickness of the plates at which these coincidences will or will not happen, in the differently coloured rays, will be different. So that it appears probable, says Dr. Priestley, in conformity to a doctrine first suggested to him by Mr. Michell, that the whole mystery of coloured plates depends upon the attractions and repulsions of the particles of the bodies that compose them, affecting different rays in a different manner, according to their thicknesses. *Hist. &c. of Light and Colours*, p. 309, &c. See *COLOURS of thin Laminæ*, &c. and *RINGS of Colours*.

Sir Isaac Newton concludes his account of the reflection of light with observing, that if light be reflected not by impinging on the solid parts of bodies, but by some other principle, it is probable that as many of its rays as impinge on the solid parts of bodies are not reflected, but stifled and lost in the bodies. Otherwise, he says, we must suppose two kinds of reflection; for should all the rays be reflected which impinge on the internal parts of clear water or crystal, those substances would rather have a cloudy colour than a clear transparency. To make bodies look black, it is necessary that many rays be stopped, retained, and lost in them; and it does not seem probable, that any rays can be stopped and stifled in them, which do not impinge on their parts: and hence, he says, we may understand, that bodies are much more rare and porous than is commonly believed. However, M. Bouguer disputes the fact of light being stifled or lost by impinging on the solid parts of bodies. See *ABSORBING*.

For other facts and observations relating to the subject of this article, see *LIGHT*. See also *RAYs of Light*, and *RAYs of Heat*.

REFLECTION, in *Catoptrics*, is the return of a ray of light from the polished surface of a speculum or mirror, as driven thence by some power residing in it.

The ray, thus returned, is called a *reflex*, or *reflected ray*, or a *ray of reflection*; and the point of the speculum, whence the return commences, is called the *point of reflection*.

Thus the ray AB (*Plate I. Optics*, fig. 3.) proceeding from the radiant A, and striking on the point of the speculum B, being returned thence to C, BC represents the *reflected ray*, and B the *point of reflection*; in respect of which AB represents the *incident ray*, or *ray of incidence*, and B the *point of incidence*.

Again, a line CG drawn from any point, as C, of the reflected

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reflected ray BC, perpendicular to the speculum, is called the *cathetus of reflection*, or *cathetus of the eye*: as a line AF, drawn from the radiant perpendicular to the speculum, is called the *incidence*.

Of the two angles which the reflected ray BC makes with the mirror, the smallest, CBE, is called the *angle of reflection*: as of the two angles the incident ray makes with the speculum, the smallest, ABD, is called the *angle of incidence*.

If the mirror be either concave or convex, the smallest angles the ray makes with the tangent to the point of reflection and incidence, are the angles of reflection and incidence.

The angle CBH, which the reflected ray makes with a perpendicular to the point of reflection, is called the *inclination of the reflected ray*: as the angle ABH is called the *inclination of the incident ray*.

REFLECTION, general laws of.—I. *If a ray of light be reflected from a speculum of any form, the angle of incidence is ever equal to the angle of reflection.* This law obtains in percussions of all kinds of bodies; and consequently must do so in those of light. See *Laws of PERCUSSION*; see also **ANGLE**.

It might therefore be here assumed as an axiom: but it is of that importance, and its demonstration so beautiful, that we cannot omit it. Suppose, then, DC (*Plate XVII. Optics, fig. 14.*) an incident ray, propagated from the radiant D: here, though the motion of the ray be simple, yet its determination in the line DC, being oblique with respect to the obstacle, is really compounded of two determinations; the one along DE, the other along DG.

The force along DC, therefore, is equal to the two forces along DG and DH. But the obstacle GF only opposes one of the determinations: viz. that along DG (for it cannot oppose a determination parallel to itself, as DE): therefore, only the force along DG will be lost by the stroke, that along DH or GC remaining entire. But a body perfectly elastic (such as we suppose the ray of light) will recover by its elasticity the force it lost by the shock.

The ray, therefore, will recover the force DG or CH: thus, retaining both its forces, and both its former determinations HC and CF, after percussing, it will be impelled along CF and CH by the same forces as before along DH and DG. By its compound motion, therefore, it will describe the right line CE, and that in the same time as DC; and HE and DH will be equal, as being described by the same force. Now, the two triangles DCH and CHE are equal, and consequently their similar angles are equal. Since then $HCA = HCF$; DCA , the angle of incidence, is equal to ECF , the angle of reflection. Q. E. D.

This law is confirmed in light by an easy experiment. For a ray of the sun falling on a mirror, in a dark room, through a little hole, you will have the pleasure to see it rebound, so as to make the angle of reflection equal to that of incidence. See *CAMERA Obscura*.

The same may be shewn various other ways: thus, *e. gr.* placing a semicircle FEG, (*Plate I. Optics, fig. 3.*) on a mirror DE, its centre on B, and its limb perpendicular to the speculum; and assuming equal arcs, Fa and Ge, place an object in A, and the eye in C: then will the object be seen by a ray reflected from the point B. And if B be covered, the object will cease to be seen.

For the conclusions drawn from this general doctrine of reflection, see the *doctrine of MIRRORS*, &c.

II. *Each point of a speculum reflects rays falling on it,*

from each part of an object. See the *doctrine of MIRRORS*, &c.

III. *If the eye C, and the radiant point A, change places, the point will continue to radiate upon the eye, in the same course or path as before.*

For if the object be removed from A to C, it will still radiate on its former point of reflection, B; but there can be but one right line drawn between the two points G and D; and the rays are right lines. Therefore, that which was before the ray of reflection, will now be the ray of incidence; and since it will be reflected under the same angle as that under which it fell, that which was before the ray of incidence, will now be the ray of reflection. So that the object removed to C, will radiate on the eye placed in A, by the right lines CB and BA. Q. E. D.

Hence, an object is seen by the reflected ray AB, with the eye placed in A, the same as if the eye were in C, and the object in A.

The truth of this theorem is so easily confirmed by experiment, that some, with Euclid, assume it as a principle, and demonstrate the great law of reflection from it. Thus: suppose the angle of incidence a little greater than the angle of reflection, then will the angle ABF be greater than CBE. Wherefore, changing the places of the eye and the object, the angle CBE will become the angle of incidence; and therefore CBE greater than ABF by the supposition. So that the same angle ABF will be both greater and smaller than the other, CBE; which being absurd, ABF cannot be greater than CBE. The same absurdity will follow, if you suppose the angle of incidence less than the angle of reflection. Since then the angle of incidence can neither be greater nor less than that of reflection, it must be equal to it.

IV. *The plane of reflection, that is, the plane in which the incident and reflected rays, and also the angles of incidence and of reflection, are found, is perpendicular to the surface of the speculum; and in spherical specula, it passes through the centre.*

Hence the cathetus, both of incidence and reflection, is in the plane of reflection.

That the plane of reflection is perpendicular to the speculum, is assumed by Euclid, Alhazen, and others, as a principle, without any demonstration; as being evident from all observation and experiment.

V. *The image of an object seen in a mirror is in the cathetus of incidence.* This the ancients assumed as a principle; and hence, since the image is certainly in the reflected ray, they inferred, it must appear in the point of concurrence of the reflected ray, with the cathetus of incidence; which indeed holds universally in plane and spherical mirrors, and usually also in concave ones, a few cases only excepted, as is shewn by Kepler.

For the particular laws of reflection, arising from the circumstances of the several kinds of specula, or mirrors, plane, concave, convex, &c. see them laid down under the article **MIRROR**.

REFLECTION, Caustic by. See **CAUSTIC CURVE**.

REFLECTION of Heat. See **HEAT**, and **RAYs of Heat**.

REFLECTION of Cold. See **COLD**.

REFLECTION of Sound. See **SOUND**.

REFLECTION of the Moon, is a term used by some authors for what we otherwise call her *variation*, being the third inequality in her motion, by which her true place out of the quadratures differs from her place twice equated. See **MOON and VARIATION**.

REFLECTION is also used, in the Copernican system, for the distance of the pole from the horizon of the disc; which

which is the same thing as the sun's declination in the Ptolemaic system.

REFLECTION is also used figuratively for an operation of the mind, by which, turning as it were back upon itself, it makes itself, and its own operation, its object; and considers or contemplates the manner, order, and laws, which it observes in perceiving, reasoning, willing, judging, doubting, believing, &c. and frames itself new ideas of the relations discovered in them.

REFLECTOIRE CURVE. See *CURVE Reflectoire*.

REFLECTOR for *Light-houses*, a combination of a number of square plane glass mirrors, resembling those with which Archimedes is said to have burnt the Roman fleet at the siege of Syracuse. (See *BURNING-Glass*.) Each of these mirrors is about an inch square; and they are all arranged close to each other in the concave of a parabolic segment formed of stucco, which has been found to answer the purpose best. The idea of thus illuminating light-houses, instead of using coal-fires, in this country, without any previous knowledge of a similar method practised in France, was first suggested by Mr. Ezekiel Walker, of Lynn Regis, who made, and fixed up reflectors under his direction, in a light-house on the coast of Norfolk, in the year 1779. Accordingly, in the year 1787, at the request of the trustees appointed by act of parliament for erecting four light-houses in the northern parts of Great Britain, he instructed Mr. Thomas Smith, tin-plate worker, of Edinburgh, to whom the original invention is erroneously ascribed in the supplement to the *Encyclopædia Britannica*, in this mode of constructing light-houses. His parabolic moulds are from three to five or six feet in diameter; and in the centre or apex of each is placed a long shallow lamp of tin-plate, filled with whale-oil. In each lamp are six cotton-wicks, almost contiguous to one another, so disposed as to burn without trimming for six hours. The light of these is reflected from each mirror spread over the concave surface, and is thus multiplied, as it were, by the number of mirrors. The stucco moulding is covered on the back with tin-plate, from which a tube, immediately over the lamp, proceeds to the roof of the light-room, and serves as a funnel, through which the smoke escapes without fulying the faces of the mirrors. The light room is a cupola or lantern of from eight to twelve sides, composed entirely of glass, fixed in cast iron frames or sashes, and roofed with copper. On circular branches passing round the inside of this lantern, at about 18 inches from the glass frames, are placed the reflectors with their lamps, so as that the concave surfaces of two or three of the reflectors front every point of the compass, and throw a blaze of light in all directions. In the roof, immediately over the centre of the room, is a hole, through which pass all the funnels already mentioned, and which serves likewise to admit fresh air to the lamps. This light-room is firmly fixed on the top of a round tower, so as to be immovable by the weather; and the number of the reflectors, and the height of the tower, are less or greater according as it is intended that the light should be seen at a less or a greater distance. Experience, it is said, has obviated several objections to which light-houses of this kind were thought to be liable; and it has been found that light-houses, with lamps and reflectors, are, in every point of view, preferable to those with fires burning in the air. They are supported at a much less expence; their light is more brilliant, and seen at a greater distance, whilst it can never be obscured by smoke, or beaten down, on the lee-side, by a violent gust of wind; and they may be so variously placed, that one light-house cannot be mistaken for another. Besides, the lamps do not need trimming so often

as open fires require fuel, and the man who attends them is never exposed either to cold or wet in the performance of his duty, so that they are less likely to be neglected in stormy weather than those with open fires.

It has been proposed to make the concave surface of the parabola one speculum of metal, instead of covering it over with a number of plain glass mirrors; or to diminish the size of each mirror, if it be thought best to retain them instead of introducing the speculum. To this proposed alteration it has been objected, that the brightest metal does not reflect such a quantity of light as well foliated clear glass; and by diminishing the size of the mirrors, the number of joinings would be increased, in each of which some light is lost, not merely in the seam, but from its being almost impossible to foliate glass perfectly at its edge.

REFLEX, REFLECT, in *Painting*, is understood of those places in a picture which are supposed to be illuminated by a light reflected from some other body represented in the same piece.

Or, reflexes may be defined those places which, beside the general light that illumines the whole piece, receive some particular light from their situation with respect to some more illuminated polished body, that reflects part of the rays it receives upon them.

Reflexes are scarcely sensible, except in the shadowed parts. The management of the reflexes requires great accuracy and skill. All reflected light is supposed to carry with it part of the colour of the body which reflects it; so that those places which receive this light, must have their colour mixed or tinged with that colour. But the same place may receive reflexes from different objects, differently coloured, and those again receive reflexes from others. The painter, therefore, must have a view to every circumstance of the colour, light, and position of each figure; he must consider what effect each has on others, and pursue nature through all the variety of mixtures. See *CLAIR-OBSCURE*, and *LIGHT*.

REFLEX *Vision*, or REFLECTED *vision*, is that performed by means of rays reflected from the polished surfaces of objects to the eye.

Reflex vision is the subject of catoptrics. Under reflex vision come all the phenomena of specula or mirrors of all kinds.

REFLEXIBILITY of the *Rays of Light*, is that property by which they are disposed to be reflected. See *REFLECTION*.

Or, it is their disposition to be turned back into the same medium, from any other medium on whose surface they fall; hence those rays are said to be more or less reflexible, which are returned back more or less easily under the same incidence.

Thus, if light pass out of glass into air, and by being inclined more and more to the common surface of the glass and air, begins at length to be totally reflected by that surface, those sorts of rays which at like incidences are reflected most copiously, or the rays which, by being inclined, begin soonest to be totally reflected, are the most reflexible rays.

That rays of light are of different colours, and endued with different degrees of reflexivity, was first discovered by sir Isaac Newton; and is shewn by the following experiment. Applying a prism DFE (*Plate XVII. Optics*, fig. 15.), whose angles are each 45°, to the aperture C of a darkened room, in such manner as that the light is reflected from the base in G; the violet rays are seen first reflected into H G; the other rays continuing still refracted in I K. After the violet the blue are all refracted, the green, &c.

(See COLOUR.) Hence it appears, that the differently coloured rays differ in degree of reflexivity.

From the other experiments it appears, that those rays which are most reflexible, are also most refrangible. See REFRAINGIBILITY.

REFLEXION. See REFLECTION.

REFLEXITY, a term employed by Mr. Brougham to denote a property of light, which causes the different rays to be acted upon by bodies, and to begin to be refracted, reflected, inflected, and deflected, at different distances. This property observes the same law with the other optical properties of light; the red ray having most reflexivity, and the violet the least. (See Phil. Trans. for 1797, p. 360.) Mr. Brougham has expressed this property by the three words, "refrangity," "reflexity," and "flexity;" but the power being the same, if such a property exist, different names seem to be unnecessary.

REFLUX of the Sea, the ebbing of the water; or its return from the shore. It is thus called, as being the opposite motion to the flood, or flux. See TIDE.

REFORM, a re-establishment, or revival of former neglected discipline; or a correction of some reigning abuses in it.

The term is much used in a monastic sense, for the reducing an order or congregation of religious to the ancient severity of the rule from which it had gradually swerved; or even for the improving on the ancient rule and institution itself, and voluntarily making it more severe.

In this sense the order of St. Bernard is said to be only a reform of that of St. Benedict.

To REFORM, in a *Military Sense*, is, after some evolution or manœuvre, to bring a line to its natural order, by aligning it on some given point. See BATTALION.

To REFORM, is also to reduce a company, regiment, or other body of men, either by disbanding the whole, or only breaking a part, and retaining the rest; or sometimes by incorporating them with other regiments. Hence,

REFORMADO, or REFORMED *officer*, one whose troop or company is suppressed in a reform, whilst he is continued either in whole or half-pay, doing duty in the regiment. A reformed captain of foot follows the company, and assists the standing officer as a second; but he still maintains his degree and precedence.

REFORMATION, REFORMATIO, the act of reforming, or correcting an error, or abuse, in religion, discipline, or the like.

The reformation of religion, called, by way of eminence, *the Reformation*, was begun by the elector of Saxony, at the solicitation of Luther, about the beginning of the sixteenth century. See LUTHER and LUTHERANISM.

There were many circumstances which concurred at this time to bring about that happy reformation in religion, which rescued one part of Europe from the papal yoke, mitigated its rigour in the other, and produced a revolution in the sentiments of mankind, the greatest as well as the most beneficial that has happened since the publication of Christianity. How far the sale of indulgences, published by Leo X., contributed to this event, we have already shewn under the article LUTHER. We shall here observe, that the same corruptions in the church of Rome which Luther condemned, had been attacked long before his appearance, and the same opinions which he propagated had been published in different places, and supported by the same arguments. Waldus in the 12th century, Wickliffe in the 14th, and Hufs in the 15th, had inveighed against the errors of Popery with great boldness, and confuted them with more ingenuity and learning than could have been expected in those illiterate ages in which

they flourished. But all these premature attempts towards a reformation proved abortive. Many powerful causes contributed to facilitate Luther's progress, which either did not exist, or did not operate with full force in their days: the principal of these we shall here enumerate. The long and scandalous schism which divided the church, during the latter part of the 14th, and the beginning of the 15th centuries, had a great effect in diminishing the veneration with which the world had been accustomed to view the papal dignity. The proceedings of the councils of Constance and Basil spread this disrespect for the Romish see still wider, and by their bold exertion of authority in deposing and electing popes, taught the world that there was in the church a jurisdiction superior even to the papal power, which they had long believed to be supreme. The wound given on that occasion to the papal authority was scarcely healed, when the pontificates of Alexander VI. and Julius II. both able princes, but detestable ecclesiastics, raised new scandal in Christendom. Besides, many of the dignified clergy, secular as well as regular, neglected the duties of their office, and indulged themselves, without reserve, in all the vices to which great wealth and idleness naturally give birth; and gross ignorance and low debauchery rendered the inferior clergy as contemptible as the others were odious. So that we find, long before the 16th century, that many authors of reputation give such description of the dissolute morals of the clergy, as seems almost incredible in the present age. The scandal of those crimes, which very generally prevailed, was greatly increased by the facility with which such as committed them obtained pardon. The exorbitant wealth of the church, the vast personal immunities of ecclesiastics, and their encroachments on the jurisdiction of the laity, and their various devices to secure their usurpations, created much dissatisfaction among the people, and disposed them to pay particular attention to the invectives of Luther. Besides these causes of his rapid progress, we may also reckon the invention of the art of printing, about half a century before his time, the revival of learning at the same period, and the bold spirit of inquiry which it excited in Europe; so that many were prepared to embrace his doctrines, who did not really wish success to his undertaking. In the writings of Reuchlin, Hutten, and the other revivers of learning in Germany, the corruptions of the church of Rome are censured with an acrimony of style little inferior to that of Luther himself. The railery and oblique censures of Erasmus in particular, upon the errors of the church, as well as upon the ignorance and vices of the clergy, prepared the way for Luther's invectives and more direct attacks. To all which we may add, that the theological doctrines of Popery were so repugnant to the spirit of Christianity, and so destitute of any foundation in reason, in the word of God, or in the practice of the church, that this circumstance combined in favouring the progress of Luther's opinions, and in weakening the resistance of his adversaries.

The rise of the reformation in Switzerland was at least as early as in Germany; for Ulric Zuingli had, in the year 1516, begun to explain the scriptures to the people, and to censure, though with great prudence and moderation, the errors of a corrupt church. He had very noble and extensive ideas of a general reformation, at the time when Luther retained almost the whole system of Popery, indulgences excepted; and he had actually called in question the authority and supremacy of the pope, before the name of Luther was known in that country. In the year 1524, Nuremberg, Francfort, Hamburgh, and several other cities in Germany, of the first rank, openly embraced the reformed religion, and by the authority of their magistrates abolished the

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the mafs, and the other fuperftitious rites of Popery. The elector of Brandenburg, Saxony, the marquis of the landgrave of Hefle, the dukes of Brunfwick and Lunenburgh, and prince of Anhalt, became avowed patrons of Luther's opinions, and countenanced the preaching of them among their fubjects. The reformers derived great advantage from the tranfactions of the diet at Nuremberg, which prefented to the pope a catalogue of a hundred grievances, which the empire imputed to the iniquitous dominion of the papal fee. The progrefs of the reformation in Germany was likewise promoted by the proceedings of the diet held at Spire in the years 1526 and 1529. See LUTHER and PROTESTANTS.

During thefe tranfactions in Germany, the dawn of truth arofe upon other nations. The light of the reformation fpread itfelf far and wide; and almoft all the European ftates welcomed its falutary beams, and exulted in the profpect of an approaching deliverance from the yoke of fuperftition and fpiritual defpotifm. Some of the moft confiderable provinces of Europe had already broke their chains, and openly withdrawn themfelves from the difcipline of Rome and the jurifdiction of its pontiff. The reformed religion was propagated in Sweden, foon after Luther's rupture with Rome, by Olaus Petri, one of his difciples, who was countenanced and encouraged by the valiant and public-fpirited prince Guftavus Vafa Ericfon, to whose firmnefs and magnanimity it was owing, that from the year 1527 the papal empire in Sweden was entirely overturned, and Guftavus declared head of the church. The light of the reformation was alfo received in Denmark fo early as the year 1521, in confequence of the ardent defire difcovered by Chriftiern II., for purpofes of mere ambition, of having his difciples instructed in the doctrines of Luther. His fucceffor Frederic, duke of Holftain and Silefia, contributed greatly to the progrefs of the reformation, by his fucceffful attempts in favour of religious liberty, at the afsembly of ftates that was held at Odenfee, in the year 1527, when he procured the publication of the famous edict which declared every fubject of Denmark free, either to adhere to the tenets of the church of Rome, or to embrace the doctrine of Luther; that no perfon fhould be molefted on account of his religion; that a royal protection fhould be granted to the Lutherans; and that ecclefiaftics of every order fhould be allowed to marry. But the honour of accomplifhing this glorious work was referved for Chriftiern III. a prince equally diftinguifhed by his piety and prudence. The religious doctrine, difcipline, and worfhip of this kingdom, were fettled according to a plan laid down by Bugenhagius. And the afsembly of the ftates at Odenfee, in 1539, gave a folemn fanction to all thefe tranfactions, and thus the work of reformation was brought to perfection in Denmark.

In the fame year the reformation was eftablifhed in every part of Saxony. Upon the death of George, duke of Saxony, who was an inveterate enemy to the reformation, the fucceffion fell to his brother Henry, whose attachment to the Proteftant religion furpaffed, if poffible, that of his predecessor to Popery. Henry invited fome Proteftant divines, and among them Luther himfelf, to Leipfic; and by their advice and affiftance, he learned, in a few weeks, the whole fyftem of ancient rites, eftablifhing the full exercife of the Proteftant religion, with the univerfal applaufe of his fubjects, who had long wifhed for this change, which the obftinacy of their former duke had alone prevented. This revolution delivered the Proteftants from the danger to which they were expofed by having an inveterate enemy fettled in the middle of their territories; and their dominions now extended in a great and almoft unbroken line from the fhore of the Baltic to the banks of the Rhine

In France, the auspicious patronage of Margaret, queen of Navarre, filler to Francis I., encouraged feveral pious and learned men, whose religious sentiments were the fame with her own, to propagate the principles of the reformation, and even to erect feveral Proteftant churches in that kingdom. It appears, that, fo early as the year 1523, there were many, and even perfons of rank, and fome of the epifcopal order, who had conceived the utmoft averfion both againft the doctrine and tyranny of Rome. But the wavering and inconfiftent conduct of Francis I. rendered the fituation of the Proteftants in this country always precarious, often diftreffed. Upon the whole, we may obferve, that, before the diet of Augfburg, the doctrine of Luther had made confiderable, though perhaps a fecret, progrefs in Spain, Hungary, Bohemia, Britain, Poland, and the Netherlands, and had, in all thefe countries, many friends, of whom feveral repaired to Wittemberg to improve their knowledge, and enlarge their views under fuch an eminent mafter. At this diet, held in 1530, the Augfburg or Auguftine confeffion was prefented to the emperor Charles V. and after many debates between the friends of liberty and the votaries of Rome, the latter prevailed; and the diet, in compliance with the opinion and remonftrances of Campeggio, the papal nuncio, iffued a decree, condemning moft of the peculiar tenets held by the Proteftants; forbidding any perfon to protect or tolerate thofe who taught them; enjoining a ftrict obfervance of the eftablifhed rites; and prohibiting any farther innovation, under fevere penalties. Thofe who refufed to obey this decree were declared incapable of acting as judges, or of appearing as parties in the imperial chamber, the fupreme court of judicature in the empire. The Proteftants, alarmed at the feverity of the decree, afsembled at Smalcald, and concluded a league of mutual defence againft all aggreffors, by which they formed the Proteftant ftates of the empire into one regular body: and they refolved to apply to the kings of England, France, and Denmark, to implore them to affift and patronize this new confederacy. After various negotiations between the emperor and the Proteftant princes, terms of pacification were agreed upon at Nuremberg, and ratified folemnly in the diet of Ratifbon, in the year 1532. In this treaty it was ftipulated, that univerfal peace be eftablifhed in Germany, until the meeting of a general council, the convocation of which, within fix months, the emperor fhall endeavour to procure; that no perfon be molefted on account of religion; that a ftop be put to all proceffes begun by the imperial chamber againft Proteftants; and the fentences already paffed to their detriment be declared void. On their part, the Proteftants engaged to affift the emperor with all their forces in refifting the invafion of the Turks. Thus the Proteftants, by their firmnefs, unanimity, and dexterity in availing themfelves of the emperor's fituation, obtained terms which amounted almoft to a toleration of their religion. But neither the emperor nor the pope were difpofed to abide by the unbialfed fense of a general council, afsembled, as the Proteftants wifhed, within the limit of the empire, but determined to decide their religious debates by the force of arms. After many evafions and delays, it was propofed, in the year 1545, to afsemble a council at Trent, which was vigorously oppofed by the Proteftants. The emperor and the pope had mutually agreed to deftroy all who fhould dare to oppofe this council. The meeting of that afsembly was to ferve as a fignal for their taking arms; and accordingly its deliberations were fearcely begun, in the year 1546, when the Proteftants perceived undoubted marks of a formidable union to overwhelm and cruft them by one blow. The fathers, afsembled in the council of Trent, promulgated their

their decrees ; and the Protestant princes in the diet of Ratisbon protested against their authority ; and were, in consequence of this, proscribed by the emperor, who raised an army to reduce them to obedience. Thus commenced the war of Smalcald, which was prosecuted with various success on both sides, till, in the year 1552, Charles was surprised at Inspruck by Maurice of Saxony, and was constrained to conclude at Passau the famous treaty of *pacification*, (which see,) with the Protestants, which is considered by those of Germany as the basis of their religious liberty ; and to promise in six months to assemble a diet, in which all the tumults and dissensions, that had been occasioned by a variety of sentiments in religious matters, should be entirely removed. This diet, though not assembled at the stipulated time, met, however, at Augsburg, in the year 1555, and terminated those deplorable scenes of bloodshed, desolation, and discord, that had so long afflicted both church and state by that *religious peace*, as it is commonly called, which secured to the Protestants the free exercise of their religion, and established this inestimable liberty upon the firmest foundations. For, after various debates, the following memorable acts were passed ; that the Protestants who followed the confession of Augsburg, should for the future be considered as entirely exempted from the jurisdiction of the Roman pontiff, and from the authority and superintendence of the bishops ; that they were left at perfect liberty to enact laws for themselves, relating to their religious sentiments, discipline, and worship ; that all the inhabitants of the German empire should be allowed to judge for themselves in religious matters, and to join themselves to that church whose doctrine and worship they thought the purest and most consonant to the spirit of Christianity ; and that all those, who should injure or persecute any person under religious pretences, and on account of their opinions, should be declared, and proceeded against, as public enemies of the empire, invaders of its liberty, and disturbers of its peace.

In the year 1533, Henry VIII. king of England, who, in the beginning of these troubles, had opposed the doctrine and views of Luther with the utmost vehemence, partly because he had spoken with contempt of Thomas Aquinas, the king's favourite author, having sued for a divorce from Catharine of Arragon, his brother's widow, at the court of Rome, for almost six years, during which period Clement VII. negotiated, promised, retracted, and concluded nothing, determined to apply to another tribunal for that decree which he had unsuccessfully solicited at Rome. Cranmer, archbishop of Canterbury, by a sentence founded on the authority of universities, doctors, and rabbies, who had been consulted with respect to the point, annulled the king's marriage with Catharine ; and Anne Boleyn, whose charms had captivated the king, was acknowledged as queen of England. Clement, apprehensive lest England would revolt from the holy see, determined to give Henry such satisfaction as might still retain him within the bosom of the church. But the violence of the cardinals precipitated him, in 1534, to issue a bull rescinding Cranmer's sentence, confirming Henry's marriage with Catharine, and declaring him excommunicated, if, within a time specified, he did not abandon the wife he had taken, and return to her whom he had deserted. Enraged at this unexpected decree, Henry kept no longer any measures with the court of Rome ; his subjects seconded his resentment ; an act of parliament was passed, abolishing the papal power and jurisdiction in England ; by another the king was declared supreme head of the church, and all the authority of which the popes were deprived was vested in him ; the *monasteries*, (which see,) were suppressed, and their revenues applied to other purposes.

The people had been gradually prepared for this great innovation. Each succeeding session of parliament had made some retrenchment from the power and profits of the Roman pontiff. Care had been taken, during some years, to teach the nation that a general council was much superior to a pope. But now a bishop preached every Sunday at Paul's Cross, in order to inculcate the doctrine, that the pope was intitled to no authority at all beyond his own diocese.

The laws passed during this session (1534) sufficiently evince, that the king was determined not to surrender any part of his assumed prerogative. All payments made to the apostolic chamber : all provisions, bulls, dispensations, were abolished : monasteries were to be subjected to the regulation and government of the king alone : the law for punishing heretics was moderated : the ordinary was prohibited from imprisoning or trying any person upon suspicion alone, without presentment by ten lawful witnesses : and it was declared that to speak against the pope's authority was no heresy : bishops were to be appointed by a *congé d'elire* from the crown, or, in case of the dean and chapter's refusal, by letters patent ; and no recourse was to be had to Rome for bulls, bulls, or provisions. Campeggio and Ghinucci, two Italians, were deprived of the bishoprics of Salisbury and Worcester, which they had hitherto enjoyed : the law which had been formerly made against paying annats, or first fruits, but which had been left in the king's power to suspend or enforce, was finally established : and a submission which was exacted two years before from the clergy, and which had been obtained with great difficulty, received this session the sanction of parliament. In this submission, the clergy acknowledged that convocations ought to be assembled by the king's authority only : they promised to enact no new canons without his consent : and they agreed that he should appoint 32 commissioners, in order to examine the old canons, and abrogate such as should be found prejudicial to his royal prerogative. An appeal was also allowed from the bishop's court to the king in chancery. But the most important act passed this session, was that which regulated the succession to the crown : the marriage of the king with Catharine was declared unlawful, void, and of no effect : the primate's sentence annulling it was ratified ; and the marriage with queen Anne was established and confirmed. The crown was appointed to defend to the issue of this marriage, and failing there, to the king's heirs for ever. An oath was likewise enjoined to be taken in favour of this order of succession, under the penalty of imprisonment during the king's pleasure, and forfeiture of goods and chattels : and all slander against the king, queen, or their issue, was subjected to the penalty of misprision of treason. These several acts, so contemptuous towards the pope, and so destructive of his authority, were passed at the very time that Clement pronounced his hasty sentence against the king. The king found his ecclesiastical subjects as compliant as the laity. The convocation ordered that the act against appeals to Rome, together with the king's appeal from the pope to a general council, should be affixed to all the doors of all the churches in the kingdom ; and they voted that the bishop of Rome had, by the laws of God, no more jurisdiction in England than any other foreign bishop ; and that the authority which he and his predecessors had there exercised, was only by usurpation, and by the sufferance of English princes. The bishops went so far in their complaisance, that they took out new commissions from the crown, in which all their spiritual and episcopal authority was expressly affirmed to be derived ultimately from the civil magistrate, and to be entirely dependent on his good pleasure.

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Henry, however, with the caprice peculiar to his character, continued to defend the doctrines of the Romish church as fiercely as he attacked their jurisdiction. He alternately persecuted the Protestants for rejecting the former, and the Catholics for acknowledging the latter.

Nothing more forwarded the first progress of the reformers, than the offer which they made, of submitting all religious doctrines to private judgment, and the summons given every one to examine the principles formerly imposed upon them. And what can be more just and reasonable? and yet the multitude, says Mr. Hume, were totally unqualified for this undertaking, though they were highly pleased with it. They fancied that they were exercising their judgment, while they opposed to the prejudices of ancient authority more powerful prejudices of another kind. The novelty itself of the doctrines; the pleasure of an imaginary triumph in dispute; the fervent zeal of the reformed preachers; their patience, and even alacrity, in suffering persecution, death, and torments; a disgust at the restraints of the old religion; an indignation against the tyranny and interested spirit of the ecclesiastics:—these motives, says the same historian, whilst, as some may imagine, he is depreciating the principles of the reformation, were prevalent with the people; and by such considerations were men so generally induced, during that age, to throw off the religion of their ancestors. In proportion, says the same author, as the practice of submitting religion to private judgment was acceptable to the people, it appeared, in some respects, dangerous to the rights of sovereigns, and seemed to destroy that implicit obedience on which the authority of the civil magistrate is chiefly founded. When some Englishmen, such were Tindal, Joye, Constantine, and others, retired to Antwerp, through fear of the exertion of the king's authority, they employed themselves in writing English books against the corruptions of the church of Rome; against images, relics, and pilgrims; and they excited the curiosity of men with regard to that question, which is the most important in theology, the terms of acceptance with the Supreme Being. These books, having been secretly conveyed to England, began to make converts every where; but it was a translation of the scriptures by Tindal that was esteemed the most dangerous to the established faith. Against Wolsey, a favourite minister of Henry VIII., it was one article of impeachment, that, by his connivance, he had encouraged the growth of heresy, and that he had protected and acquitted some notorious offenders. Wolsey was succeeded in the office of chancellor by sir Thomas More, who, irritated by polemics, became so superstitiously attached to the ancient faith, that few inquisitors have been guilty of greater violence in their prosecution of heresy. Several persons were not only brought into the courts for heretical offences, such as teaching their children the Lord's prayer in English, for reading the New Testament in that language, or for speaking against pilgrimages; and others were charged with the capital offences of harbouring persecuted preachers, neglecting the faults of the church, and declaiming against the vices of the clergy. Some were tried, condemned, and committed to the flames. Notwithstanding the inconsistent conduct of Henry, his subjects having been encouraged, by his example, to break some of their fetters, were so impatient to shake off all that remained, that in the following reign, under his son Edward VI., with the general applause of the nation, a total separation was made from the church of Rome in articles of doctrine, as well as in matters of discipline and jurisdiction. (See ARTICLES.) In 1553, his death retarded the progress of the reformation; and his sister Mary, who succeeded him, imposed a new the arbitrary

laws and tyrannical yoke of Rome upon the people of England. But the execution of a great number of persons, who were burnt for the Protestant faith in the five years of her persecuting and bloody reign, so alienated the people from Popery, that queen Elizabeth, her sister, found it no hard matter to deliver her subjects from the bondage of Rome, and to establish that form of religious doctrine and ecclesiastical government, which still subsists in England.

The seeds of the reformation were very early sown in Scotland, by several noblemen of that nation, who had resided in Germany during the religious disputes that divided the empire. The first and most eminent opposer of the Papal jurisdiction was John Knox, a disciple of Calvin, who set out from Geneva for Scotland in 1559, and in a little while prevailed with the greatest part of the Scotch nation entirely to abandon the superstitions of Rome, and to aim at nothing less than the total extirpation of Popery. In the following year, *viz.* 1560, the parliament ratified a confession of faith, agreeable to the new doctrines, and passing a statute against the mass, not only abolished it in all the churches, but enacted, that whoever, any where, either officiated in it, or was present at it, should be chastised, for the first offence, with confiscation of goods, and corporal punishment, at the discretion of the magistrate; for the second, with banishment; and for the third, with loss of life. A law was also voted for abolishing the Papal jurisdiction in Scotland; the Presbyterian form of discipline was settled, leaving only at first some shadow of authority to certain ecclesiastics, whom they called superintendents. From that period to the present times the form of doctrine, worship, and discipline, that had been established at Geneva by the ministry of Calvin, has been maintained in Scotland with invincible obstinacy and zeal; and every attempt to introduce, into that kingdom, the rites and government of the church of England, has proved impotent and unsuccessful. See PRESBYTERIANS.

The cause of the reformation in Ireland underwent the same vicissitudes that had attended it in England. When Henry VIII., after the abolition of the Papal authority, was declared supreme head of the church of England, George Brown, a native of England, and a monk of the Augustin order, whom that monarch had created, in the year 1535, archbishop of Dublin, began to act with the utmost vigour, in consequence of this change in the hierarchy. He purged the churches of his diocese from superstition in all its forms, pulled down images, destroyed relics, abolished absurd and idolatrous rites, and, by the influence as well as authority he had in Ireland, caused the king's supremacy to be acknowledged in that nation. Henry shewed soon after, that this supremacy was not a vain title; for he banished the monks out of that kingdom, confiscated their revenues, and destroyed their convents. In the reign of Edward VI. farther progress was made in the reformation, but the accession of Mary retarded it, in consequence of which Brown and other Protestant bishops were deprived of their dignities in the church. When Elizabeth ascended the throne, the Irish were again obliged to submit to the form of worship and discipline established in England.

The reformation had not been long established in Britain, when the Belgic provinces, united by a respectable confederacy which still subsists, withdrew from their spiritual allegiance to the Roman pontiff. The means which Philip II. king of Spain used to obstruct the reformation, promoted it: the nobility formed themselves into an association, in the year 1566, and roused the people; who, under the heroic conduct of William of Nassau, prince of Orange, seconded by the succours of England and France, delivered this state from

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from the Spanish yoke: in consequence of which the reformed religion, as it was professed in Switzerland, was established in the United Provinces; and, at the same time, an universal toleration granted to those whose religious sentiments were of a different nature, whether they retained the faith of Rome, or embraced the reformation in another form, provided that they made no attempts against the authority of the government, or the tranquillity of the public.

Whilst Mr. Hume attributes the quick and surprising progress of the reformation in part to the late invention of printing, and revival of learning, he denies that reason had any considerable share in opening men's eyes with regard to the impostures of the Romish church; alleging that philosophy had made little progress, at least not till long after the period of the reformation, and that no instance occurs in which argument has ever been able to free the people from that enormous load of absurdity with which superstition has every where overwhelmed them: to which he adds, that the rapid advance of the Lutheran doctrine, and the violence with which it was embraced, prove sufficiently that it owed not its success to reason and reflection. The art of printing, and the revival of learning, he says, forwarded its progress in another manner. By means of that art, the books of Luther and his sectaries, full of vehemence, declamation, and a rude eloquence, were propagated more quickly, and in greater numbers. The minds of men, somewhat awakened from a profound sleep of so many centuries, were prepared for every novelty, and scrupled less to tread in any unusual path which was opened to them. And as copies of the scriptures, and other ancient monuments of the Christian faith, became more common, men perceived the innovations which were introduced after the first century; and though argument and reasoning could not give conviction, an historical fact, well supported, was able to make impression on their understandings. As the ecclesiastics would not agree to possess their privileges, though ancient and prior to almost every political establishment in Europe, as matters of civil right, which time might render valid, but appealed still to a divine right, they thus tempted men to look to their primitive charter, which, with little difficulty, they could perceive to be defective in truth and authenticity. Besides, Luther and his followers, not satisfied with opposing the pretended divinity of the Romish church, and displaying the temporal inconveniences of that establishment, proceeded to treat the religion of their ancestors as abominable, detestable, and damnable; foretold by sacred writ itself as the source of all wickedness and pollution. They denominated the pope antichrist, called his communion the scarlet whore, and gave to Rome the appellation of Babylon; expressions which, however applied, were to be found in scripture, and which were better calculated to operate on the multitude than the most solid arguments. Excited by contest and persecution on the one hand, by success and applause on the other, many of the reformers carried to the greatest extremities their opposition to the church of Rome; and in contradiction to the multiplied superstitions with which that communion was loaded, they adopted an enthusiastic strain of devotion, which admitted of no observances, rites, or ceremonies, but placed all merit in a mysterious species of faith, in inward vision, rapture, and ecstacy. The new sectaries, seized with this spirit, were indefatigable in the propagation of their doctrine, and set at defiance all the anathemas and punishments with which the Roman pontiff endeavoured to overwhelm them.

Thus, in terms which appear to us too disparaging, does our historian describe the origin and progress of the reformation; nor does he pay due respect to the principles on which

it was founded, and to the character of the persons who were the principal agents in accomplishing it. We are ready to acknowledge, that the collateral circumstances above recited rendered its advances more rapid and more extensive; but we cannot allow that it did not owe much of its success to reason and reflection. But whatever may be our opinion of the primary causes that produced it, its influence on the minds and manners of mankind, on the state of society in general, and on the interests of liberty, religion, and virtue, has been eminently and extensively beneficial. Luther had no sooner began to attack the papal supremacy, than the charm, which had bound mankind for so many ages, was broken at once. The human mind, which had long continued as tame and passive, as if it had been taught to believe whatever was taught, and to bear whatever was imposed, roused of a sudden, and became inquisitive, mutinous, and disdainful of the yoke to which it had hitherto submitted. The reformation, wherever it was received, increased that bold and innovating spirit to which it owed its birth. Men who had the courage to overturn a system, supported by every thing which can command respect or reverence, were not to be overawed by any authority, how great or venerable soever. After having been accustomed to consider themselves as judges of the most important doctrines in religion, to examine these freely, and to reject, without scruple, what appeared to them erroneous, it was natural for them to turn the same daring and inquisitive eye to government, and to think of rectifying whatever disorders or imperfections were discovered there. As religious abuses had been reformed in several places, without the permission of the magistrate, it was an easy transition to attempt the redress of political grievances in the same manner. But though the spirit of innovation, that was excited and promoted by the reformation, might in some instances prove the occasion of turbulence and tumult, the good that eventually accrued from its operation far exceeded the partial and temporary evil that resulted from it. The prevalence of this spirit was so general, that it must have been excited by causes that were natural, and of powerful efficacy; and the consequences that flowed from them must have been as important and interesting as the causes that produced them. The kingdoms of Denmark, Sweden, England, and Scotland, and almost one half of Germany, threw off their allegiance to the pope, abolished his jurisdiction within their territories, and gave the sanction of law to modes of discipline and systems of doctrine, which were not only independent of his power, but hostile to it. Nor was this spirit of innovation confined to those countries which openly revolted from the pope; it spread through all Europe, and broke out in every part of it with various degrees of violence. It penetrated early into France, and made such rapid progress, that the number of converts to the opinions of the reformers was so great, their zeal so enterprising, and the abilities of their leaders so distinguished, that they soon ventured to contend for superiority with the established church, and were sometimes on the point of obtaining it. In all the provinces of Germany which continued to acknowledge the papal supremacy, as well as in the Low Countries, the Protestant doctrines were secretly taught, and had gained so many proselytes, that they were ripe for revolt, and were restrained merely by the dread of their rulers from imitating the example of their neighbours, and asserting their independence: hence in Spain and Italy, symptoms of the same disposition to shake off the yoke appeared. The pretensions of the pope to infallible knowledge and supreme power were treated by many persons of eminent learning and abilities with such scorn, or impugned with

with such vehemence, that the most vigilant attention of the civil magistrate, the highest strains of pontifical authority, and all the rigour of the inquisitorial jurisdiction, were requisite to check or extinguish it. The defection of so many opulent and powerful kingdoms from the papal see was a fatal blow to its grandeur and power, and produced a very considerable diminution of its revenues. It likewise obliged the Roman pontiffs to adopt a different system of conduct towards the nations which continued to recognize their jurisdiction, and to govern them by new maxims, and with a milder spirit. They became afraid of venturing upon any such exertion of their authority as might alarm or exasperate their subjects, and excite them to a new revolt. Hence it happens, that the popes, from the era of the reformation, have ruled rather by address and management than by authority. They have been obliged not only to accommodate themselves to the notions of their adherents, but to pay some regard to the prejudices of their enemies. In process of time, and before the convulsions which have lately agitated Europe, they sunk almost to a level with the other petty princes of Italy; and they hardly retain any shadow of the temporal power which they anciently possessed. Nevertheless, whilst the reformation has been fatal to the power of the popes, it has contributed to improve the church of Rome both in science and in morals. Many motives have arisen out of the reformation, and the existence of two rival churches, which have served to engage the Catholic clergy to apply themselves to the study of useful science, and to pay a strict attention to the manners of their clergy. In those countries where the members of the two churches have mingled freely with each other, or have carried on any considerable intercourse, either commercial or literary, an extraordinary alteration in the ideas, as well as in the morals, of the Popish ecclesiastics is manifest. The beneficial influence of the reformation has not only been felt by the clergy, and the inferior members of the Roman Catholic church; but it has extended to the see of Rome, and to the sovereign pontiffs themselves, whose character, at a later period, has been very different from that of several of their predecessors. Many of them have been conspicuous for the virtues becoming their high station; and by their humanity, their love of literature, and their moderation, have made some atonement to mankind for the crimes of those who in former times occupied their places. Thus the reformation has eminently contributed to increase purity of manners, to diffuse science, and to inspire humanity. With the progress of the reformation we may also connect a variety of other important benefits, both to individuals and to society; and as they pertain to the investigation of truth and the improvement of science, to the promotion of liberty both civil and religious, to the diffusion of knowledge and virtue, and to the advancement of the best interests of mankind. But the details of the advantages resulting from the reformation to nations and private persons, to religion in general, and genuine Christianity in particular, would far exceed the limits to which we are confined.

See, on the subject of this article, Robertson's *Hist. of Charles V.* vol. ii. p. 113, &c. vol. iii. p. 44, &c. Moheim's *Eccles. Hist.* Eng. ed. 8vo. vol. iii. Burnet's *Hist. of the Reformation*, passim. For a comprehensive, and, upon the whole, a just sketch of the predisposing causes, and beneficial consequences of the reformation, we refer the reader to a work which obtained the prize proposed by the National Institute of France, 15th of Germinal, in the year X. viz. "What has been the influence of the reformation by Luther on the political situation of the different states of Europe, and on the progress of knowledge?" The work

is entitled "An Essay on the Spirit and Influence of the Reformation by Luther," by C. Villers. We have two English translations, one by B. Lambert, and the other by James Mill, 8vo. 1805.

REFORMATION, *Right of, Jus reformationis*, is a right which the princes of Germany claim to reform the church in their respective territories; as being invested with the spiritual as well as the temporal power.

The *jus reformationis* is annexed to the sovereignty; by this they have the power of conscience, the disposition of ecclesiastical revenues, &c. as they enjoyed the same at the treaty of Munster in 1624.

REFORMATION of Images, in *Optics*. See ANAMORPHOSIS.

REFORMED Calendar and Church. See the substantives.

REFORMED Officer. See REFORMADO.

REFRACTED ANGLE, in *Optics*, the angle contained between the refracted ray and the perpendicular.

REFRACTED Dials, are such as shew the hour by means of some refracting transparent fluid. See DIALS, *Refracted*.

REFRACTED Ray, or ray of refraction. See RAY and REFRACTION.

REFRACTED Vision. See VISION.

REFRACTING TELESCOPE. See TELESCOPE.

REFRACTION, REFRACTIO, in *Mechanics*, the deviation of a moving body from its direct course, by reason of the different density of the medium it moves in; or a flexion and change of determination, occasioned by a body's falling obliquely out of one medium into another of a different density.

Thus a ball A (*Plate XXXVI. Mechanics, fig. 14.*) moving in the air in the line A B, and falling obliquely on the surface of the water C D, does not proceed straight to E, but deviates, or is inflected, to F. Again, if the ball, moving in water in the same line A B, should fall obliquely on a surface of air C D; it will not proceed straight to E, nor yet deflect to F, but to G. Now the deflection in each case is called the *refraction*: and the two cases are distinguished by means of the perpendicular M I; that B G being called *refraction towards the perpendicular*, or to the axis of refraction; and the other B F, *refraction from the perpendicular*, or from the axis of refraction.

These refractions are supposed to arise hence, that the ball arriving at B, in the first case finds more resistance or opposition on the one side O, i. e. from the side of the water, than it did from the side P, or that of the air; and in the latter more resistance from the side P, which is now the side of the water, than the side O, which is that of the air.

The great law of refraction, then, which holds in all bodies, and all mediums, is that a body, passing obliquely out of a medium which resists it more, is refracted towards the perpendicular; and in passing out of a medium which opposes it less into another which opposes it more, it is refracted from the perpendicular.

Hence the rays of light falling out of air into water are refracted towards the perpendicular; whereas a ball thrown into the water is refracted from it; because water, which resists the motion of light less than air, resists that of the ball more; or, to speak more justly, because water, by its greater attraction, accelerates the motion of the rays of light more than air does; for that this is the true cause of refraction, at least in light, shall be shewn under REFRACTION of light.

To have a body refracted, it is necessary that it should fall obliquely on the second medium. In perpendicular incidence there is no refraction.

REFRACTION.

Vossius indeed, and Snellius, imagined they had observed a perpendicular ray of light undergo a refraction; a perpendicular object appearing in the water nearer than in reality it was; but this was to attribute that to a refraction of the perpendicular rays, which was owing to the divergency of the oblique rays after refraction, from a nearer point.

Yet there is a manifest refraction even of perpendicular rays found in *Iceland Crystal*, which see.

Rohault adds, that though an oblique incidence be necessary in all other mediums we know of, yet the oblique must not exceed a certain degree; if it do, the body will not penetrate the medium, but will be reflected instead of being refracted.

Thus cannon-balls, in sea-engagements, falling very obliquely on the surface of the water, are observed to mount aloft again, and frequently to sweep the men from off the opposite decks; and the like happens to the little stones with which children make their ducks and drakes.

The ancients confounded refraction with reflection, and it was sir Isaac Newton who first taught us the just difference between them. He shews likewise, that there is a good deal of analogy between them, and particularly in the case of light.

The laws of refraction of the rays of light in mediums differently terminated, *i. e.* whose surfaces are plain, concave, convex, &c. make the subject of *dioptrics*; which see.

By refraction it is, that convex glasses, or lenses, collect the rays, magnify objects, burn, &c. and hence the foundation of microscopes, telescopes, &c.

By refraction it is, that all remote objects are seen out of their real places; particularly, that the heavenly bodies are apparently higher than they are in reality, &c.

The refraction of the air has many times so uncertain an influence on the places of celestial objects, very remote from the zenith, that wherever refraction is concerned, the conclusions deduced from observations that are much affected by it, will always remain doubtful, and too precarious in many cases to be relied upon. See Dr. Bradley, in *Phil. Trans.* N^o 485. See *Atmospherical Refraction*.

Refraction of Light, in *Optics*, is an inflection or deviation of the rays from their rectilinear course upon falling obliquely out of one medium into another, of a different density.

The term refraction is derived from the distortion which it occasions in the appearance of an object viewed in part only by refracted light; thus, an oar, partially immersed in water, appears to be bent, on account of the refraction of the light, by which its lower part is seen, in its passage out of the water into the air.

Although no sensible light can penetrate more than 700 feet deep into the sea, and a length of seven feet of water has been found to intercept one-half of the light which enters into it; yet in transparent substances (no medium being, strictly speaking, absolutely transparent) the greater part of the light penetrates to all distances with little interruption, and all rays, of the same kind, thus transmitted by the same surface, form with the perpendicular an angle of refraction, which is ultimately in a certain constant proportion to the angle of incidence; that is, for instance, one-half, three-fourths, or two-thirds, according to the nature of the surface. Thus, if the refractive properties of the substance were such, that an incident ray, making an angle of one degree with the perpendicular, would be so refracted as to make an angle of only half a degree with the same line, another ray, incident at an angle of two degrees, would be refracted, without sensible error, into an angle of one degree. But when the angles are larger, they vary

from this ratio, their sines only preserving the proportion with accuracy: for example, if the angle of incidence at the supposed surface were increased to 90° , the angle of refraction would be 30° only, instead of 45° .

It does not appear that, before Descartes, any person attempted to explain the physical cause of the refraction, and also the reflection of light, which he undertook to do by the resolution of forces, on the principles of mechanics; in consequence of which he was obliged to suppose that light passes with more ease through a dense medium than a rare one: thus the ray AB (*Plate XVIII. Optics, fig. 10.*) falling obliquely on a denser medium at B, is supposed to be acted on by two forces, one of them impelling it in the direction AC, and the other in AD, which alone can be affected by the change of medium: and since, after the ray has entered the denser medium, it approaches the perpendicular BH, it is plain that this force must have received an increase, whilst the other continued the same; for if BE be taken equal to BD, or CA, the consequence of the angle IBH being less than ABC will be, that BH must be longer than BC or AD.

The first person who questioned the truth of this explanation of the cause of refraction was M. Fermat, who asserted, contrary to Descartes, that light suffers greater resistance in water than in air, and greater in glass than in water; and he maintained that the resistance of different mediums, with respect to light, is in proportion to their densities. M. Leibnitz adopted the same general idea; and they reasoned upon the subject in the following manner. Nature, they say, accomplishes her ends by the shortest methods; light, therefore, ought to pass from one point to another, either by the shortest road, or that in which the least time is required. But it is plain that the line in which light passes, when it falls obliquely upon a denser medium, is not the most direct or the shortest; so that it must be that in which the least time is spent. And, whereas it is demonstrable, that light falling obliquely upon a denser medium (in order to take up the least time possible, in passing from a point in one medium to a point in the other), must be refracted in such a manner, that the sines of the angles of incidence and refraction must be to one another, as the different facilities with which light is transmitted in those mediums; it follows that, since light approaches the perpendicular when it passes obliquely from air into water (so that the sine of the angle of refraction is less than that of the angle of incidence), the facility with which water suffers light to pass through it is less than that of the air; so that the light meets with greater resistance in water than in air. This method of arguing from final causes could not satisfy philosophers. Dr. Smith observes that it agrees only to the case of refraction at a plain surface; and that the hypothesis is altogether arbitrary. If he had endeavoured to accommodate his principle to concave and convex surfaces, as he had once proposed, he would soon have perceived its insufficiency. The easiest way for a ray to pass from a given point in any resisting medium into a vacuum, is in a perpendicular to the refracting surface, this being the shortest way, through any difficulty or resistance whatever; but this being reduced to nothing at the refracting surface, it may then take any other course in vacuo, without any farther difficulty; and, on the contrary, in returning back from the vacuum into the dense medium, it must take the shortest course through the same perpendicular as before. Thus, when the sun shines upon the atmosphere, all his rays should be refracted into lines tending to the centre of the earth, as being the shortest and easiest way through the atmosphere, and then we should see the sun exactly over our heads, in all places and at all times. Such is the strange conse-

consequence that follows from an hypothesis so arbitrary.

Dechales, in order to explain the law of refraction, supposes that every ray of light is composed of several smaller rays, which adhere to one another; and that they are refracted towards the perpendicular, in passing into a denser medium, because one part of the ray meets with more resistance than another part; so that the former traverses a smaller space than the latter; in consequence of which the ray must necessarily bend a little towards the perpendicular. This hypothesis was adopted by the famous Dr. Barrow, who, as some say, was the author of it. On this hypothesis, it is plain that mediums of a greater refractive power must give greater resistance to the passage of the rays of light than mediums of a less refractive power, which is contrary to fact.

The Bernouillis, both father and son, have attempted to explain the cause of refraction on mechanical principles; the former on the equilibrium of forces, and the latter on the same principles with the supposition of ethereal vortices; but neither of these hypotheses have gained much credit. M. Mairan supposes a subtle fluid, filling the pores of all bodies, and extending, like an atmosphere, to a small distance beyond their surfaces; and then he supposes that the refraction of light is nothing more than a necessary and mechanical effect of the incidence of a small body in those circumstances. There is more, he says, of the refracting fluid in water than in air, less in water than in glass, and in general less in a dense medium than in one that is rarer. M. de Maupertuis supposes that the course which every ray takes, in passing from one medium into another, is that which requires the least quantity of action, which depends upon the velocity of the body, and the space it passes over; so that it is in proportion to the sum of the spaces, multiplied by the velocity with which bodies pass over them. From this principle he deduces the necessity of the sine of the angle of incidence being in a constant proportion to that of refraction: and also all the other laws relating to the propagation and reflection of light.

Dr. Smith (in his *Optics*, Remarks, p. 70.) observes, that all other theories for explaining the reflection and refractions of light, except sir Isaac Newton's, suppose that it strikes upon bodies, and is resisted by them, which has never been proved by any deduction from experience. On the contrary, it appears by various considerations, and might be shewn by Mr. Molyneux's and professor Bradley's observations on the parallax of the fixed stars, that their rays are not at all impelled by the rapid motion of the earth's atmosphere, nor by the object-glass of the telescope through which they pass. And by sir Isaac Newton's theory of refraction, which is grounded on experience only, it appears, that light is so far from being resisted and retarded by refraction into any dense medium, that it is swifter there than in vacuo, in the ratio of the sine of incidence in vacuo to the sine of refraction into the dense medium. From some cases of the production of colours, we are led to suppose, says Dr. Young (*Lect. Phil.* vol. i. p. 460.) that the velocity of light must be smaller in a denser than in a rarer medium; and supposing this fact to be established, the existence of such an attractive force as sir Isaac Newton suggests could no longer be allowed; nor, he says, could the system of the emanation of light, in opposition to that of the undulation of an ethereal medium, be maintained by any one. Priestley's *Hist. of Light*, &c. p. 102, &c. p. 333, &c.

The refraction of light, sir Isaac Newton shews, is not performed by the very rays falling on the surface of bodies; but it is done without any contact, by the action of some power belonging to bodies, and extending to a certain dis-

tance without their surfaces; by which same power, acting in other circumstances, they are also emitted and reflected.

Admitting that certain powers of attraction and repulsion belong to bodies, and extend to a certain distance beyond their surfaces, and supposing also that light consists of particles emitted from luminous bodies, sir Isaac Newton demonstrates, in his "*Principia*," that the sine of the angle of incidence must be always to the sine of the angle of refraction in some certain ratio. For, as he proves geometrically, if two similar mediums be separated from each other by a space terminated on both sides by parallel planes, and a body, in its passage through that space, be attracted or impelled perpendicularly towards either of those mediums, and not agitated or hindered by any other force; and if the attraction be every where the same, at equal distances from either plane, taken towards the same hand of the plane, the sine of incidence upon either plane will be to the sine of emergence from the other plane in a given ratio.

In a corollary to this proposition he also shews, that if, instead of one parallel space, bodies be surrounded with several, or an infinite number of them, the attractive power of each of which differs from the next, increasing or decreasing, still, the ratio respecting any two contiguous ones being given, the ratio of the extremes will be given. He also demonstrates, that, if the cause of refraction be the attraction of the refracting medium, the velocity of light before its incidence will be to its velocity afterwards, as the sine of the angle of refraction is to the sine of the angle of incidence; so that light, in passing from a rarer medium into a denser, receives an increase of velocity. The same things being supposed, he shews, that if the velocity before incidence be greater than afterwards, so that the angle of emergence must always increase, in consequence of the repulsive power prevailing over the attractive one, the body will at length be reflected; and that, in this case, the angle of reflection must necessarily be equal to the angle of incidence.

That light does not consist of any mode of action upon a fluid medium, he concludes from having demonstrated that pressure cannot be propagated through a fluid in rectilinear directions, unless where the particles of the fluid lie in a right line, but must diverge into the unmoved spaces; and that every tremulous body, in an elastic medium, propagates the motion of the pulses on every side straight forwards. Admitting this, there is hardly any hypothesis that will agree with the phenomena of light, but that of particles emitted from the luminous body, affected by the attractions and repulsions of other bodies.

The same arguments by which we have proved, that *reflection* (which see) is performed without immediate contact, will go a great way towards demonstrating the same of *refraction*: to which may be added the following ones.

1. Because, if when light falls out of glass into air with the utmost obliquity it will be transmitted at, it be then made to fall a little more obliquely, it becomes wholly reflected: for the power of the glass, after it has refracted light emerging as obliquely as possible, supposing the rays to fall still more obliquely, will be too strong to let any of the rays pass; consequently, instead of being refracted, they will all be reflected.

2. Because in thin lamellæ, or plates of glass, light is reflected and transmitted several times alternately, as the thickness of the lamellæ increases in arithmetical progression; for here it depends on the thickness of the lamina which of the two the glass shall do, whether reflect it, or let it be transmitted.

3. Because, whereas the power of other bodies both to reflect and refract light are very nearly proportional to their

densities; yet unctuous and sulphureous bodies are found to reflect more strongly than according to their mere densities; for as the rays act more strongly on those bodies to kindle them than on others, so do they again, by their mutual attraction, act more strongly on the rays to refract them.

Lastly; Because not only those rays transmitted through glass are found to be refracted, but also those passing in the air, or in a vacuum near its extremities, or even near the extremes of many opaque bodies, *e. gr.* the edge of a knife, undergo a similar inflection, from the attraction of the body. See LIGHT, and also INFLECTION.

The manner in which refraction is performed by mere attraction, without contact, may be thus accounted for: suppose HI (Plate XVIII. Optics, fig. 11.) the boundary of two mediums, N and O ; the first the rarer, *e. gr.* air; the second the denser, *e. gr.* glass; the attractions of the mediums here will be as their densities. Suppose pS to be the distance to which the attracting force of the denser medium exerts itself within the rarer. Let now a ray of light AA fall obliquely on the surface which separates the mediums, or rather on the surface pS , where the action of the second and more resisting medium commences. All attraction being performed in lines perpendicular to the attractive body, as the ray arrives at a , it will begin to be turned out of its rectilinear course by a superior force, with which it is attracted by the medium O , more than by the medium N , *i. e.* by a force with which it is driven towards it in a direction perpendicular to its surface: hence the ray is bent out of its right line in every point of its passage between pS and RT , within which distance the attraction acts. Between those lines, therefore, it describes a curve ABb ; but beyond RT , being out of the sphere of attraction of the medium N , it will proceed uniformly in a right line, according to the direction of the curve in the point b .

Again, suppose N the denser and more resisting medium, O the rarer, and HI the boundary, as before; and let RT be the distance to which the denser medium exerts its attractive force within the rarer: even when the ray has passed the point B , it will be within the sphere of superior attraction of the denser medium; but that attraction acting in lines perpendicular to its surface, the ray will be continually drawn from its straight course BM perpendicularly towards HI : thus, having two forces or directions, it will have a compound motion, by which, instead of BM , it will describe Bm , which Bm will in strictness be a curve.

Lastly, after it has arrived in m , being out of the influence of the medium N , it will persist uniformly in a right line, in the direction in which the extreme of the curve leaves it.

Thus we see how refraction is performed, both towards the perpendicular, and from it.

But note, the attraction of the denser medium, *e. gr.* N , is continually diminishing, as the ray proceeds from B , towards the limit of attraction RT ; because fewer and fewer parts still come to act; at IH , *e. gr.* all the parts between that and pS attract; but at RT , none but those in the line HI . Note, also, that the distance between pS and RT being small, when we consider refractions, no notice is taken of the curve part of the ray, but we consider it as consisting of two straight lines, CB , AB , or mB , AB .

Sir Isaac Newton, not content with ascribing the reflection, refraction, and inflection of light to powers of attraction and repulsion, extending beyond the surfaces of bodies and producing effect in the manner above explained, proposes a conjecture concerning the physical cause of this attraction and repulsion; but his hypothesis is no less liable to difficulties and objections than the hypothesis of the me-

chanical production of the motion of light without attraction or repulsion. Does not the refraction of light, he says, arise from the different density of an ethereal medium in different places, the light always receding from the denser parts of the medium? And is not the density of it greater in free and open spaces void of air, and other gross bodies, than within the pores of water, glass, crystal, gems, and other compact bodies? For when light passes through glass or crystal, and falling very obliquely upon the farther surface, is all reflected, the total reflection ought to arise rather from the density and vigour of the medium without and beyond the glass, than from the rarity and weakness of it.— Does not the ethereal medium, in passing out of water, glass, crystal, and other compact and dense bodies, into empty spaces, grow denser and denser by degrees, and by that means refract the rays of light, not in a point, but by bending them gradually in curve lines? And does not the gradual condensation of this medium extend to some distance from the bodies, and thereby cause the inflections of the rays of light, which pass by the edges of the dense bodies, at some distance from the bodies?

REFRACTION, in *Dioptrics*, is the inflection or bending of the rays of light, in passing the surfaces of glasses, lenses, and other transparent bodies of different densities.

Thus a ray, as AB (Plate XVIII. Optics, fig. 11.) falling obliquely from the radiant A , upon a point B , in a diaphanous surface, HI , rarer or denser than the medium along which it was propagated from the radiant; has its direction there altered by the action of the new medium; and instead of proceeding to M , it deviates, *e. gr.* to C .

This deviation is called the *refraction of the ray*; BC the *refracted ray*; or *line of refraction*; and B the *point of refraction*.

The line AB is called the *line of incidence*, or *ray of incidence*; and, in respect of it, B is also called the *point of incidence*.

The plane in which both the incident and refracted rays are found, is called the *plane of refraction*; a right line BE , drawn in the refracting medium perpendicular to the refracting surface, in the point of refraction B , is called the *axis of refraction*: and a right line DB , drawn perpendicular to the refracting surface, in the point of incidence B , along the medium through which the ray fell, is called the *axis of incidence*.

The angle ABI , included between the incident ray and the refracting surface, is called the *angle of incidence*; and the angle ABD , included between the incident ray and the axis of incidence, is called the *angle of inclination*. The angle MBC , which the refracted ray makes with the incident, is called the *angle of refraction*: and the angle CBE , which the refracted ray makes with the axis of refraction, is called the *refracted angle*.

REFRACTION, general laws of. 1. A ray of light in its passage out of a rarer into a denser medium, *e. gr.* out of air into glass, is refracted towards the perpendicular, *i. e.* towards the axis of refraction.

Hence, the refracted angle is less than the angle of inclination; and the angle of refraction less than that of incidence; as they would be equal were the ray to proceed straight from A to M . Hence, also, a ray perpendicular to the refracting surface, will pass through without being refracted, as it cannot be refracted to the perpendicular. The physical cause of which is, that the attraction of the denser medium, which, in an incidence oblique to its surface acts perpendicularly to that surface, draws the ray out of its course: this attraction, we say, in a perpendicular incidence, acts in the direction of the ray.

2. The ratio of the sine of the angle of inclination, to the sine

REFRACTION.

fine of the refracted angle, is fixed and constant; viz. if the refraction be out of air into glass, it is found greater than as 114 to 76, but less than 115 to 76; that is, nearly as 3 to 2.

This ratio, assigned by Huygens, agrees with another of Sir Isaac Newton, who makes the fine of the angle of inclination to the fine of the refracted angle, as 31 to 20; which is, likewise, nearly as 3 to 2. Indeed, there is some difference in the quantity of refraction, in different kinds of glass; but in physical matters, preciseness is not necessary. In rain-water, Descartes found the ratio of the fine of the angle of inclination, to the fine of the refracted angle, as 250 to 187, that is nearly as 4 to 3; which agrees with Sir Isaac Newton's observation, who makes it as 529 to 396. In spirit of wine, the same great author makes the ratio as 100 to 75; which is not far from the sesquitertian ratio. In air he makes it as 3201 to 3200; and as to air, he shews, that a ray of light, in traversing quite through the atmosphere, is refracted the same as it would be, were it to pass with the same obliquity out of a vacuum into air of equal density with that in the lowest part of the atmosphere.

See the following table, in which the proportion of the lines which measure the refractions of several bodies; the densities of the bodies, estimated by their specific gravity; and their refractive power, in respect of their densities, are set down in separate columns.

The refracting bodies.	The proportion of the lines of incidence and refraction of yellow light.	The density and specific gravity of the body.	The refractive power of the body in respect of its density.
A pseudo-topaz, being a natural, pellucid, brittle, hairy stone, of a yellow colour	23 to	14.4.27	3979
Air	3201 to	3200.0.0012	5208
Glass of antimony	17 to	9.5.28	4864
A selenites	61 to	41.2.252	5386
Glass vulgar	31 to	20.2.58	5436
Crystal of the rock	25 to	16.2.65	5450
Island crystal	5 to	3.2.72	6536
Sal gemmæ	17 to	11.2.143	6477
Alum	35 to	24.1.714	6570
Borax	22 to	15.1.714	6716
Nitre	32 to	21.1.9	7079
Dantzick vitriol	303 to	200.1.715	7551
Oil of vitriol	10 to	7.1.7	6124
Rain-water	529 to	396.1.	7845
Gum arabic	31 to	21.1.375	8574
Spirit of wine well rectified	100 to	73.0.866	10121
Camphor	3 to	2.0.996	12551
Olive oil	22 to	15.0.913	12607
Linseed oil	40 to	27.0.932	12819
Spirit of turpentine	25 to	17.0.874	13222
Amber	14 to	9.1.04	13654
A diamond	100 to	41.3.4	14556

Newton's Optics, edit. 3. p. 247.

M. Euler the younger, pursuing a scheme suggested by his father for ascertaining the refractive powers of transparent liquors, made use of two Meniscus glasses, which he put together when they were plunged in the fluid, the refractive power of which he wanted to determine: the

edges of these glasses being ground flat, they immediately colored, so that none of the fluid could escape; and then they might both together be wiped, and used as one object-glass in a long tube, which he could lengthen or shorten at pleasure; and applying an eye-glass to it, the whole observation he had to make was to measure the exact length of his tube, when he could see through it most distinctly a turret, which was at a considerable distance from him. Or, when the focal distance was less than a foot, he only observed, at what distance from a wall the image of an opposite window was the most distinct. Ac. Berlin. 1762, p. 302.

The refractive power of the fluids which he examined in this manner, he expressed in the following tables.

		The fine of the angle of incidence will be to that of refraction as
A ray of light passing from air into		
Distilled water	- - -	1.3358
Rain-water	- - -	1.3358
Well-water	- - -	1.3366
French wine	- - -	1.3453
French brandy	- - -	1.3603
Ditto a stronger kind	- - -	1.3646
Rectified spirit of wine	- - -	1.3685
Ditto more highly rectified	- - -	1.3706
The white of an egg	- - -	1.3685
Distilled vinegar	- - -	1.3442
A solution of gum arabic	- - -	1.3467
A solution of two scruples of white sugar in an ounce of water	- - -	1.3457
A solution of two scruples of rock-salt, in ditto	- - -	1.3477
A solution of two scruples of salt of urine, in ditto	- - -	1.3400
Oil of Provence	- - -	1.4651
Oil of turpentine	- - -	1.4822

To unity.

N. B. The rock-salt and the salt of urine were purified by a double crystallization.

		The fine of the angle of incidence will be to that of refraction as
By a second pair of Meniscuses.		
Distilled water	- - -	1.3358
Rain-water	- - -	1.3358
Well-water	- - -	1.3362
French wine	- - -	1.3458
French brandy	- - -	1.3600
Ditto a stronger kind	- - -	1.3618
Spirit of wine rectified	- - -	1.3683
Ditto more highly rectified	- - -	1.3705
Tea	- - -	1.3376
Mineral alkali saturated (I suppose with water)	- - -	1.3600
Spirit of nitre	- - -	1.4025
A solution of two scruples of Glauber's salt in an ounce of water	- - -	1.3430
A solution of two scruples of digestive salt of Sylvius in ditto	- - -	1.3454
A solution of two scruples of sal ammoniac in ditto	- - -	1.3488
A solution of two scruples of copperas in ditto	- - -	1.3395
Oil of tartar per deliquium	- - -	1.3917
Oil of Provence	- - -	1.4648
Oil of turpentine	- - -	1.4822

To unity.

REFRACTION.

The refractive power of some other fluids found by the second pair of Meniscuses, 18th August, 1761, Reaumur's thermometer being 31 degrees above the freezing point.

	The sine of the angle of incidence will be to that of refraction as
A ray of light passing from air into Well-water	1.3351
Four different solutions of nitre, viz.	
Twelve grains of depurated nitre to an ounce of water	1.3380
Twenty-four grains of depurated nitre to an ounce of water	1.3398
Thirty-eight grains of depurated nitre to an ounce of water	1.3450
Thirty-eight grains of depurated nitre to two ounces of water	1.3540
Four different infusions	
of parsley	1.3355
of nutshells	1.3359
of saffron	1.3363
of fish-scales	1.3353
of Zeltzer water	1.3353
of Eger water	1.3358
Anodyne liquor	1.3650
Spirit of camphor	1.3757
Spirit of Saxon soap	1.4088

That the refractive power of these fluids, thus determined by M. Euler, may be more easily compared with Mr. Hauksbee's and sir Isaac Newton's experiments, he reduced the result of their observations into the following tables, exactly similar to his own.

The refractive power of certain fluids found by Mr. Hauksbee, see his Experiments, p. 292.

	The sine of the angle of incidence will be to that of refraction as
A ray of light passing from air into	
Water	1.3359
Spirit of honey	1.3359
Spirit of sal ammoniac	1.3377
Oil of amber	1.3377
Spirit of hartshorn	1.3390
Human urine	1.3419
White of an egg	1.3511
Jelly of hartshorn	1.3541
French brandy	1.3626
Spirit of wine	1.3721
Distilled vinegar	1.3721
Gum ammoniac	1.3723
Aqua regia	1.3898
Ditto from aqua fortis and sal ammoniac	1.3964
Aqua fortis	1.4044
Spirit of nitre	1.4076
The crystalline humour of an ox's eye	1.4635
Butter of antimony	1.6831
Oil of vitriol	1.4262
Oil of wax	1.4524
Oil of lavender	1.4960
Oil of rosemary	1.4719
Oil of origanum	1.4770
Oil of ginger	1.4769
Oil of oranges	1.4833
Oil of turpentine	1.4833
Oil of tawine	1.4857

To unity.

To unity.

The sine of the angle of incidence will be to that of refraction as

Oil of flowers of musk	1.4878
Oil of mint	1.4911
Oil of amber	1.5010
Oil of cummin	1.5088
Oil of fennel	1.5114
Oil of cloves	1.5136
Oil of anise	1.5191
Oil of cinnamon	1.5340
Oil of saffraus	1.5443

To unity.

The refractive powers of some transparent liquors according to the observations of sir Isaac Newton. See Optics, p. 247.

The sine of the angle of incidence will be to that of refraction as

A ray of light passing from air into	
A yellow pseudo-topaz	1.6429
Air	0.9997
Glass of antimony	1.8889
A selenites	1.4878
Glass	1.5500
Crystal of the rock	1.5620
Island crystal	1.6666
Sal gem	1.5455
Alum	1.4577
Borax	1.4667
Nitre	1.5238
Dantzick vitriol	1.5000
Oil of vitriol	1.4285
Rain-water	1.3358
Gum arabic	1.4771
Spirit of wine well rectified	1.3698
Camphor	1.5000
Olive oil	1.4666
Linseed oil	1.4814
Spirit of turpentine	1.5625
Amber	1.5556
A diamond	2.4390

To unity.

See Priestley's Hist. of Light, &c. p. 479, &c.

Whence the different refractive power in different fluids arises, is not determined. Sir Isaac Newton shews, that in many bodies, *e. gr.* glass crystal, a selenites, pseudo-topaz, &c. the refractive power is proportionable to their densities; only in sulphureous bodies, as camphor, linseed oil, olive, amber, spirit of turpentine &c. the power is two or three times greater than in other bodies of equal density; yet even these have the refractive power with respect to each other nearly as their densities.

Water has a refractive power in a middle degree between those two kinds of substances, and is, probably, of a middle nature. Salts and vitriols have refractive powers in a middle degree between those of earthy substances and water, and accordingly are composed of those two sorts of substances. Spirit of wine has a refractive power in a middle degree between those of water and oily substances; and accordingly seems to be composed of both, united by fermentation. It appears, therefore, that all bodies seem to have their refractive powers proportional to their densities, or very nearly, excepting so far as they partake of more or less sulphureous oily particles, and thereby have their refractive powers made greater or less. Whence it seems reasonable to attribute the refractive power of all bodies

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bodies chiefly, if not wholly, to the sulphureous parts with which they abound.

From the observations of M. Euler it appears, that there is no fluid, and probably no transparent substance of any kind, the refractive power of which is less than that of rain-water, or distilled water; and betwixt air and rain-water there is no substance that has an intermediate refractive power.

After rain-water immediately follows well-water; but there are probably as many varieties in its refractive power as there are different wells. We may, however, conclude, that the ratio of refraction from air into well-water is contained between the limits of 1.336 to 1, and 1.337 to 1.

Spirituos liquors have a greater refractive power in proportion to their strength: but the ratio of refraction from air into any spirituous liquor is never less than 1.34, nor greater than 1.37.

There is, probably, no kind of salt, but what, being dissolved in water, increases its refractive power.

The solutions of salt of urine and of vitriol have the least refractive powers, and those of rock-salt and sal ammoniac the greatest; but the ratio of refraction from air into any saline solution, preserving the proportion of one ounce of salt to twelve of water, will be contained between the limits of 1.34 to 1. and 1.35 to 1.

Distilled vinegar, and the solution of gum arabic, have nearly the same refractive power with common French wine; and the refractive power of white of egg is the same as that of rectified spirit of wine.

Mineral alkali saturated, seems to have the same refractive power with very strong brandy.

Spirit of nitre and oil of tartar per deliquium have a medium refractive power between spirituous liquors and oils.

The refractive powers of oils approach the nearest to that of glass, especially oil of turpentine, which had the greatest refractive power of all the fluids on which he had made experiments.

Sir Isaac Newton suspected that different degrees of heat might have some effect on the refractive power of bodies, but his method of determining the general refraction was not sufficiently accurate to ascertain this circumstance; but happily this method of M. Euler's proved to be well adapted to this purpose.

From his experiments made for this purpose, he infers, that the focal distance of a single lens of glass diminishes with the heat communicated to it; and this diminution of the focal distance is not owing to the increase of bulk in the glass by heat; for the effect of this change is both inconsiderable, and of a contrary nature. There can be no doubt, therefore, but that this alteration in the focal distance is owing to a change in the refractive power of the glass itself, which, as well as, probably, that of all other transparent substances, is increased by heat, and diminished by cold.

It may seem surprising that the focal distance of a single lens should decrease with heat, and yet that of the meniscuses filled with any fluid, should increase with heat; but M. Euler observes, that it by no means follows from hence, that these fluids are affected by heat in a manner different from glass; and, after computing the effect of every circumstance of this complex experiment, of the two glasses, and the fluid combined, he concludes, that heat increases the refractive power of water, and of other fluids, as well as that of glass.

He farther observes, that as 66 degrees of heat diminished the focal distance $\frac{1}{10}$ th part, 33 degrees ought to have dimi-

nished it $\frac{1}{20}$ th part; whereas the diminution in this case was $\frac{1}{10}$ th. From hence, says he, one may perhaps conclude, that when it is very cold, the same change in the thermometer has a greater effect on the refractive power of the glass than when it is very hot. But he acknowledges that experiments of this kind are not capable of so much precision as one could wish, and that, perhaps in reality, the 66 degrees made a change of $\frac{1}{10}$ th, and the 33 degrees of $\frac{1}{20}$ th; but he imagined that a great number of experiments, made in different temperatures of the air, might decide this question, especially if object-glasses of a very great focal distance were made use of. *Ac. Berl. 1762.*

The duke de Chaulnes, not satisfied with the methods used by Newton and others for determining the refractive power of glass, proposed another mode of doing it, which is very ingenious, and, when well conducted, promising success. He formed the glass into plates, the surfaces of which were truly plane and parallel, and having placed small objects on each of them, he found, by means of a compound microscope, to which he applied the most exquisite micrometer, the different distances at which they were distinctly visible, and compared them with the thickness of the glass. This, he says, gives the proportion of the sines of the angles of incidence and refraction in that kind of glass directly. In this method he ascertained the mean refractive power of 15 kinds of glass. *Ac. Par. 1767.* See Priestley's *Hist. of Light*, &c. p. 483, &c.

Dr. W. H. Wollaston has proposed a new method of examining refractive as well as dispersive powers, by prismatic reflection. This method was suggested by a consideration of sir Isaac Newton's prismatic eye-glass, the principle of which depends on the reflection of light at the inner surface of a dense refracting medium.

Since the range of inclination, within which total reflection takes place, depends not only on the density of the reflecting prism, but also on the rarity of the medium adjacent to it, the extent of that range varies with the difference of the densities of the two media. When, therefore, the refractive power of one medium is known, that of any rarer medium may be learned, by examining at what angle a ray of light will be reflected from it.

For instance, when any object is laid under a prism of flint-glass, with air alone interposed, the internal angle of incidence at which the visual ray begins to be totally reflected, and at which the object ceases to be seen by refraction, is about $39^{\circ} 10'$; but when the object has been dipped in water, and brought into contact with the glass, it continues visible, by means of the higher refractive power of the water, as far as $57^{\circ} \frac{1}{2}$ of incidence. When any kind of oil, or any resinous cement, is interposed, this angle is still greater, according to the refractive power of the medium employed; and, by cements that refract more strongly than the glass, the object may be seen through the prism, at whatever angle of incidence it is viewed.

In examining the refractive powers of fluids, or of fusible substances, the requisite contact is easily obtained; but, with solids, which can in few instances be made to touch to any great extent, this cannot be effected without the interposition of some fluid, or cement, of higher refractive power than the medium under examination. Since the surfaces of a stratum so interposed are parallel, it will not effect the total deviation of a ray passing through it, and may therefore be employed without risk of any error in consequence.

Thus, resin, or oil of saffras, interposed between plate-glass and any other prism, will not alter the result.

If, on the same prism, a piece of selenite and another of plate-glass be cemented near each other, their powers may

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be compared with the same accuracy as if they were both in absolute contact with it.

For such a mere comparison of any two bodies, a common triangular prism is best adapted; but, for the purpose of actual measurement of refractive powers, Dr. Wollaston has preferred the use of a square prism, because, with a very simple apparatus, it shews the fine of refractive power sought, without the need of any calculation.

Let Δ (*Plate XVIII. Optics, fig. 12.*) be a square or rectangular prism, to which any substance is applied at b , and let any ray of light parallel to cb be refracted through the prism, in the direction bdc .

Then, if ef and ed be taken proportional to the sines that represent the refractive powers of the prism and of air, fg , which is intercepted between f and the perpendicular eg , will be the corresponding sine to represent the refractive power of the medium b . For since edg (opposite to cf) is the angle of refraction, efg (opposite to ed) must be equal to the angle of incidence bdb ; and $ef : fg :: bd : db :: \text{fine of } cbi : \text{fine of } bbd$.

All, therefore, that is requisite for determining the refractive power of b , is to find the means of measuring the line fg . On this principle, the instrument in *fig. 13* is constructed. On a board, ab , is fixed a piece of flat deal cd , to which, by a hinge at d , is jointed a second piece de , 10 inches long, carrying two plane sights at its extremities. At e is a second hinge, connecting ef , 15.83 inches long; and a third at the other extremity of ef , by which fg is connected with it. At i also is a hinge, uniting the radius ig to the middle of ef ; and then, since g moves in a semicircle egf , a line joining e and g would be perpendicular to fg .

The piece cd has a cavity in the middle of it, so that, when any substance is applied to the middle of the prism P , it may continue to rest horizontally on its extremities. When ed has been so elevated, that the yellow rays in the fringe of colours (observable where perfect reflection terminates) are seen through the sights, the point g , by means of a vernier which it carries, shews by inspection the length of the sign of refraction sought.

The advantages which this method possesses above the usual mode of examining refractive powers, are greater than they may at first sight appear. The usual practice has been, to form two surfaces of the substance under examination, so inclined to each other that the deviation occasioned by them might be measured. The inclination of these surfaces to each other must also be known; and thence the refractive power might be computed. But, in the method here proposed, it is sufficient to have only one surface, and the result is obtained at once, without computation.

The facility of determining refractive powers is consequently such as to render this property of bodies a very convenient test in many philosophical inquiries.

The following table exhibits a series of substances, arranged according to their refractive powers.

Diamond	-	-	-	-	2.44
Plumbago	-	-	-	-	—
Native sulphur (double)	-	-	-	-	2.04
Glass, consisting of lead 6 and sand 1	-	-	-	-	1.987
Glass of antimony	-	-	-	-	1.98
Jargon	-	-	-	-	1.95
Spinelle ruby	-	-	-	-	1.812
Arfenic	-	-	-	-	1.811
Muriate of antimony, variable.	-	-	-	-	—
White sapphire	-	-	-	-	1.768
Gum dragon	-	-	-	-	—

Iceland spar, strongest	-	-	-	1.657
Sulphate of barytes (double)	-	-	-	1.647
Balsam of Tolu	-	-	-	1.60
Guaiacum	-	-	-	1.596
Benzoin	-	-	-	—
Flint glass	-	-	-	1.586
Ditto	-	-	-	1.583
Horn	-	-	-	—
Phosphorus	-	-	-	1.579
Mica	-	-	-	—
Opium	-	-	-	—
Amber	-	-	-	1.547
Rock crystal (double)	-	-	-	1.547
Old plate-glass	-	-	-	1.545
Colophony	-	-	-	1.543
Box-wood	-	-	-	—
Bees-wax	-	-	-	1.542
Oil ofassafras	-	-	-	1.536
Red sealing-wax	-	-	-	—
Spermaceti, cold	-	-	-	—
Sugar, after fusion	-	-	-	—
Arfeniate of potash	-	-	-	—
Mastic	-	-	-	—
Elemi	-	-	-	—
White wax (cold)	-	-	-	—
Oil of cloves	-	-	-	1.535
Copal	-	-	-	1.535
Anime	-	-	-	1.535
Radeliffe crown-glass	-	-	-	1.533
Pitch	-	-	-	—
Centre of crystalline of fish, and dry crystalline of an ox	-	-	-	1.530
Canada balsam	-	-	-	1.528
Crown glass, common	-	-	-	1.525
Selenite	-	-	-	1.525
Caoutchouc	-	-	-	1.524
Gum lac	-	-	-	—
Dutch plate-glass	-	-	-	1.517
Human cuticle	-	-	-	—
Gum arabic	-	-	-	1.514
Balsam of capivi	-	-	-	1.507
Oil of amber	-	-	-	1.505
English plate-glass	-	-	-	1.504
French plate-glass	-	-	-	1.500
Oil of nutmeg	-	-	-	1.497
Sulphate of potash	-	-	-	1.495
Tallow, cold	-	-	-	1.49
Iceland spar, weakest	-	-	-	1.488
Camphor	-	-	-	1.487
Linseed oil	-	-	-	1.485
Butter, cold	-	-	-	1.480
Essence of lemon	-	-	-	1.476
Oil of turpentine, common	-	-	-	1.476
Oil of turpentine, rectified	-	-	-	1.470
Oil of almonds	-	-	-	—
Oil of olives	-	-	-	1.469
Oil of peppermint	-	-	-	1.468
Oil of lavender	-	-	-	1.467
Tallow, melted	-	-	-	1.460
Alum	-	-	-	1.457
Spermaceti, melted	-	-	-	1.446
Crystalline lens of an ox	-	-	-	1.447
to	-	-	-	1.380
Computed average of ditto	-	-	-	1.430
Sulphuric acid	-	-	-	1.435
Fluor spar	-	-	-	1.433
Nitric acid (sp. gr. 1.48)	-	-	-	1.410
Alcohol	-	-	-	—

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Alcohol	-	-	-	1.37
White of an egg	-	-	-	1.36
Æther	-	-	-	1.358
Vitreous humour of an eye	-	-	-	1.336
Water	-	-	-	1.336
Atmospheric air (Hauksbee)	-	-	-	1.00032

See Phil. Tranf. vol. xcii. for 1802. art. 12. See Dis-
PERSION of Light.

From the law laid down in the beginning of this article, it follows, that one angle of inclination, and its corresponding refracted angle, being found by observation, the refracted angles, corresponding to the several other angles of inclination, are easily computed. Now, Zahnus and Kircher have found, that if the angle of inclination be 70° , the refracted angle will be $38^\circ 50'$; on which principle Zahnus has constructed a table of refractions out of air into glass, for the several degrees of the angle of inclination; a specimen of which follows:

Angle of Inclination.	Refracted Angle.			Angle of Refraction.		
°	°	'	"	°	'	"
1	0	40	5	0	19	55
2	1	20	6	0	39	54
3	2	0	3	0	59	56
4	2	40	5	1	19	55
5	3	20	3	1	39	57
10	6	39	16	3	20	44
20	13	11	35	6	48	25
30	19	29	29	10	30	31
45	28	9	19	16	50	41
90	41	51	40	48	8	20

Hence it appears, that if the angle of inclination be less than 20° , the angle of refraction out of air into glass is almost one-third of the angle of inclination; and, therefore, a ray is refracted to the axis of refraction, by almost a third part of the quantity of its angle of inclination. And on this principle it is that Kepler, and most other dioptrical writers, demonstrate the refractions in glasses; though in estimating the law of these refractions, he followed the example of Alhazen and Vitellio, and sought to discover it in the proportion of the angles, and not in that of the sines.

The true law of refraction was first discovered by Willebrord Snellius, professor of mathematics at Leyden; who found by experiment that the secants of the complements, or co-secants, of the angles of incidence and refraction, are always in the same ratio. It is vulgarly attributed, however, to Descartes; who having seen it in Snellius's MS., first published it in his Dioptrics, without naming Snellius; as we are informed by Huygens. The form in which Descartes gives this law is different from that of Snellius, and in general more commodious; but it might have been easily deduced from it. According to him, the sine of the angle of refraction always bears the same proportion to the sine of the angle of incidence. Indeed, as the rays of light are not all of the same degree of refrangibility, this constant ratio must be different in different kinds. The ratio, therefore, observed by authors, is to be understood of rays of the mean refrangibility, *i. e.* of green rays. The difference of refraction between the least and most refrangible rays, that is, between violet and red rays, Sir Isaac Newton shows is about the $27\frac{1}{2}$ th part of the whole refraction of the mean

refrangible; which difference he owns is so small, that there seldom needs to be any regard paid to it.

3. When a ray passes out of a denser into a rarer medium, *c. gr.* out of glass into air, it is refracted from the perpendicular, or from the axis of refraction. And hence the angle of refraction is greater than the angle of inclination.

Hence, also, if the angle of inclination be less than 30° , M B C (Plate XVIII. Optics, fig. 11.) is nearly equal to one-third of M B E; therefore M B C is one-half of C B E; consequently, if the refraction be out of glass into air, and the angle of inclination less than 30° , the ray is refracted from the axis of refraction by almost one-half part of the angle of inclination. And this is the other dioptrical principle used by most authors after Kepler, to demonstrate the refraction of glasses.

If the refraction be out of air into glass, the ratio of the sine of inclination to the sine of the refracted angle is as 3 to 2, or, more accurately, as 17 to 11; if out of air into water, as 4 to 3: therefore, if the refraction be the contrary way, *viz.* out of glass or water into air, the ratio of the sines, in the former case, will be as 2 to 3, or 11 to 17, and in the latter as 3 to 4.

Hence, if the refraction be from water or glass into air, and the angle of incidence or inclination be greater than about $48\frac{1}{2}^\circ$ in water, or greater than about 40° in glass, the ray will not be refracted into air, but will be reflected into a line, which makes the angle of reflection equal to the angle of incidence; because the sines of $48\frac{1}{2}^\circ$ and 40° are to the radius as 3 to 4, and as 11 to 17 nearly, and therefore when the sine has a greater proportion to the radius than as above, the ray will not be refracted.

4. A ray falling on a curve surface, whether concave or convex, is refracted after the same manner as if it fell on a plane which is a tangent to the curve in the point of incidence.

For the curve and plane surface touching it, have an infinitely small part common to them both (each being originally generated by the flux of a point). But a ray is refracted in such a little part; therefore it is the same as if it were refracted in such a plane.

5. If a right line E F (Plate XVIII. Optics, fig. 14.) cut a refracting surface, G H, at right angles; and if, from any point in the denser medium, as D, be drawn D C parallel to the incident ray A B: this will meet the refracted ray in C; and will be to it as the sine of the refracted angle to the sine of the angle of inclination.

For $o = x$; but if B C pass out of a denser medium into a rarer, $y > x$; and out of a rarer into a denser, $y < x$; therefore, in the former case, $y > o$, in the latter $y < o$; consequently, in the former, $o + u < y + u$; in the latter $y + u < o + u$. But in the one case $o + u$, and in the other $y + u$, are equal to two right angles; therefore, $o + u$ in this, and $y + u$ in the other, are less than two right angles, and consequently D C will meet B C. But since $o = x$, or the angle of inclination, and y is the refracted angle, it is evident that C B is to C D as the sine of the angle o to the sine of the angle y , or in the ratio of the sine of the angle of inclination to the sine of the refracted angle.

Hence, if B C pass out of glass into air, it is in a sub-sesquialterate ratio to C D; if, on the other hand, it passes out of air into glass, it is in a sesquialterate ratio to C D.

Hence, also, if light pass out of water into air; C B is in a sub-sesquitercian ratio to C D; if out of air into water, in a sesquitercian. See figs. 14 and 15.

REFRACTION in plane surfaces, laws of. 1. If parallel rays be refracted out of one transparent medium into another of a dif-

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a different density, they will continue parallel after refraction. The physical reason is, that, being parallel, their obliquity, or angle of incidence, is the same; but, at equal obliquities, we have shewn the refraction is equal; consequently the parallelism, which they had before the refraction, will be retained after it.

But this may be also demonstrated geometrically: thus, if the rays be perpendicular to the refracting surface, they will pass without any refraction; consequently being parallel before their passage, they will be so after it. If they fall obliquely, as AB and CD (*fig. 16.*), the angles of incidence o and u , and, consequently, also the angles of inclination x and y , will be equal. But the sines of the angles of inclination x and y have the same ratio to the sines of the refracted angles m and n ; therefore the refracted angles m and n , and also the angles s and r , are equal; consequently the refracted rays are parallel.

Hence a glass, plane on both side, being turned directly to the sun, the light passing through it will be propagated after the same manner as if the glass were away; for the rays being perpendicular, will pass without refraction. If the glass be turned obliquely to the sun, the light, after refraction, will be of the same intensity as before, the intensity depending on the spissitude or closeness of the rays, and on the angle with which they strike the object, or the eye; both which are here unvaried.

2. If two rays DC and CP (*fig. 17.*) proceeding from the same radiant C , and falling on a plane surface of a different density, so that the points of refraction D and P are equally distant from the cathetus of incidence GK , the refracted rays DF and PQ have the same virtual focus, or the same point of dispersion G .

Hence, 1. Since, in rays very near each other, the distance from the cathetus is the same as to sense, very near rays will diverge from the same point G , *i. e.* they will have the same virtual focus G .

And hence, 2. When refracted rays, falling on the eye placed out of the cathetus of incidence, are either equally distant from the cathetus, or very near each other, they will flow upon the eye, as if they came to it from the point G ; consequently the point C will be seen by the refracted rays as in G .

3. If a ray CD fall obliquely out of a thinner into a denser medium, having a plane surface, the distance of the radiant point CK will have a less ratio to the distance of the point of dispersion, or virtual focus, KG , than the sine of the refracted angle to the sine of the angle of inclination. But if the distance of the point of refraction, from the cathetus of incidence KD , be less than the eleventh or nineteenth part of the distance of the radiant point CK ; and if in the former case the tenth, and in the latter the hundredth, part of it be so small, that it cannot be assigned, or need not be minded, then will CK be to KG , as to sense, in the ratio of the sine of the refracted angle, to the sine of the angle of inclination.

Hence, 1. If the refraction be out of air into glass, the distance of the point of dispersion of rays near the cathetus is sesquialterate of the radiant point; of more remote rays greater than sesquialterate. But if the refraction be out of air into water, the distance of the same point will be sesquitertian, when the rays are near the cathetus; and when more remote, greater than sesquitertian.

Hence, 2. If the eye be placed in a dense medium, objects in a rarer will appear more remote than they are; and the place of the image, in any given case, may be determined from the ratio of the refraction. *Thus, to fishes swimming under*

water, objects out of the water must appear farther distant than in reality they are.

4. If a ray DG fall obliquely out of a denser into a rarer medium AB , the distance of the radiant point GK has a greater ratio to the distance of the point of dispersion KC , than the sine of the refracted angle has to the sine of the angle of inclination. In the other case of the preceding theorem, KG will be to KC , as to sense, in the ratio of the sine of the refracted angle, to the sine of the angle of inclination.

Hence, 1. If the refraction be out of glass into air, the distance of the point of dispersion of the rays near the cathetus of incidence is subsequalterate of the distance of the radiant point; that of the more remote rays is less than subsequalterate.

But, 2. If the refraction be out of water into air, the distance of the point of dispersion of rays near the cathetus is subsequitertian; of those more remote, less than subsequitertian.

And, 3. The eye, therefore, being placed in a rarer medium, objects, placed in a denser, appear nearer than they are; and the place of the image may be determined in any given case by the ratio of refraction. Hence, the bottom of a vessel full of water is raised by refraction to a third part of its height, with respect to an eye perpendicularly over the refracting surface; and hence *fishes, and other bodies under water, appear nearer than they really are.*

5. If the eye be placed in a rarer medium, an object seen in a denser medium, by a ray refracted in a plane surface, will appear larger than it really is. If the object be in a rarer, and the eye in a denser medium, the object will appear less than it is. And, in each case, the apparent magnitude is to the real one in a ratio compounded of the distance of the point to which the rays tend before refraction, from the refracting surface DE (*fig. 18.*) to the distance of the eye GL from the same, and of the distance GM of the object AB from the eye, to its distance FM from a point F , to which the rays tend before refraction.

Hence, 1. If the object AB be very remote, FM will be physically equal to GM ; and, therefore, the real magnitude MB is to its apparent one MH , as GL to FL , or the distance of the eye G from the refracting plane to the distance of the point of convergence F from the same plane.

Hence, 2. *Objects under water, to an eye in the air, appear larger than they are; and to fishes under water, objects in the air appear less than they are.*

REFRACTION, *Laws of, in spherical surfaces, both concave and convex.* 1. A ray of light DE (*fig. 19.*) parallel to the axis of a denser sphere, after a single refraction in E , falls in with the axis in the point F , beyond the centre C .

For the semidiameter CE , drawn to the point of refraction E , is perpendicular to the surface KL , and is therefore the axis of refraction; but a ray out of a rarer into a denser medium, we have shewn, is refracted towards the perpendicular, or the axis of refraction; therefore the ray DE will converge to the axis of the sphere AF ; and will, therefore, at length concur with it, and that beyond the centre C , in F ; because the angle of refraction FEH is less than the angle of inclination CEH .

2. If a ray DE fall on a spherically convex surface of a denser medium, parallel to its axis AF ; the semidiameter CE will be to the refracted ray EF in the ratio of the sine of the angle of refraction, to the sine of the angle of inclination; but the distance of the focus, or point of concurrence from the centre CF , is to the refracted ray FE , in the ratio

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ratio of the sine of the refracted angle, to the sine of the angle of inclination.

3. If a ray DE fall on a denser spherical convex surface KL , parallel to the axis AF , the distance of the focus from the refracting surface FB must be to its distance from the centre FC , in a ratio greater than that of the sine of the angle of inclination, to the sine of the refracted angle. But if the rays be very near the axis, and the angle of inclination BCE be only of a few degrees, the distances of the focus from the surface, and the centre, FB and FC , will be nearly in the ratio of the sine of the angle of inclination, to the sine of the refracted angle.

Hence, 1. If the refraction be out of air into glass; in the case of rays near the axis, $BF : FC :: 3 : 2$. And in the case of rays remote from the axis, $BF : FC > 3 : 2$. Consequently, in the former case, $BC : BF :: 1 : 3$; and in the latter, $BC : BF < 1 : 3$.

And, 2. If the refraction be out of air into water; in the former case, $BF : FC :: 4 : 3$; and in the latter, $BF : FC > 4 : 3$. Consequently, in the former, $BC : BF :: 1 : 4$; and in the latter, $BC : BF < 1 : 4$.

Hence, 3. Since the sun's rays are parallel as to sense, if they fall on the surface of a solid glass sphere, or of a sphere full of water, they will not concur with the axis within the sphere; so that Vitellio was mistaken, when he imagined, that the sun's rays, falling on the surface of a crystalline sphere, were refracted to the centre.

4. If a ray DE (*fig. 20.*), parallel to the axis FA , fall out of a denser into a rarer spherical medium, after refraction, it will diverge from the axis; and the distance of the point of dispersion, or the virtual focus from the centre of the sphere FC , will be to its semi-diameter CE in the ratio of the sine of the refracted angle, to the sine of the angle of refraction; but to the portion of the refracted ray drawn back, FE , it will be in the ratio of the sine of the refracted angle, to the sine of the angle of inclination.

5. If a ray ED fall parallel to the axis AF on the spherically convex surface KL of a rarer medium, out of a denser, the distance of the point of dispersion from the centre FC , is to its distance from the surface FB , in a ratio greater than that of the sine of the refracted angle to the sine of the angle of inclination. But if the rays DE be very near the axis FA , the ratio will be very nearly the same with that of the sine of the refracted angle to the sine of the angle of inclination.

Hence, 1. If the refraction be out of glass into air, in the case of rays near the axis, $FC : FB :: 3 : 2$. Consequently $BC : FB :: 1 : 2$. Therefore, in the case of rays more remote from the axis, $FC : FB > 3 : 2$.

2. If the refraction be out of water into air; in the former case $FC : FB :: 4 : 3$. Consequently, $BC : FB :: 1 : 3$; in the latter case therefore, $FC : FB > 4 : 3$.

3. Since then the point of dispersion F is more remote from the refracting surface KL , if the rays proceed out of water, than if they pass out of glass into air; parallel rays are less dispersed in the former case than in the latter.

6. If a ray HE (*fig. 19.*) fall parallel to the axis FA , out of a rarer, on the surface of a spherically concave denser medium; the refracted ray EN will be driven from the point of the axis F ; so that FE will be to FC in the ratio of the sine of the angle of inclination, to the sine of the refracted angle.

7. If a ray EH fall parallel to the axis FB on the concave surface KL of a spherical denser medium, from a rarer; the distance of the point of dispersion from the refracting surface FB , is to its distance from the centre FC ,

in a ratio greater than that of the sine of the angle of inclination, to the sine of the refracted angle. But if the rays be very near the axis, and the angle BCE be very small, BF will be to CF very nearly in the ratio of the sine of the angle of inclination, to the sine of the refracted angle.

Hence, 1. If the refraction be out of air into glass; in the case of rays near the axis, $FB : FC :: 3 : 2$; in the case of rays more remote from the axis, $FB : FC > 3 : 2$; consequently, in the former, $BC : FC :: 1 : 2$. And hence, in the latter, $BC : FC < 1 : 2$.

Hence also, 2. If the refraction be out of air into water; in the case of rays near the axis, $FB : FC :: 4 : 3$. In the case of rays more remote from the axis, $FB : FC > 4 : 3$; consequently, in the first case, $BC : FC :: 1 : 3$. And hence, in the latter, $BC : FC > 1 : 3$.

And hence, 3. Since the point of dispersion F is farther from the centre C , if the refraction be in water than in air; rays will be less dispersed in the latter case than in the former.

8. If the ray HE (*fig. 20.*) fall parallel to the axis AF , from a denser upon the surface of a spherical concave rarer medium, the refracted ray will concur with the axis AF , in the point F ; so that the distance of the point of concurrence from the centre CF , may be to the refracted ray FE , in the ratio of the sine of the refracted angle, to the sine of the angle of inclination.

9. If a ray HE fall parallel to the axis AF on the concave surface of a rarer medium out of a denser, the distance of the focus from the centre FC will be to its distance from the refracting surface FB in a greater proportion than the sine of the refracted angle, to the sine of the angle of inclination. But if the rays be very near the axis, FC will be to FB in the proportion of these sines.

Hence, 1. If the refraction be out of glass into air; in the case of rays near the axis, $FC : FB :: 3 : 2$; in the case of rays more remote from the axis, $FC : FB > 3 : 2$. Whence, in the former case, $BC : FB :: 1 : 2$.

2. If the refraction be out of water into air; in the case of rays near the axis, $FC : FB :: 4 : 3$; in the case of rays more remote, $FC : FB > 4 : 3$. Whence, in the former case, $BC : FB :: 1 : 3$. For the demonstration of these several laws of refraction, we refer to Wollius's *Elem. Mathes. &c.* tom. iii. p. 179, &c. See also LENS.

REFRACTION in a glass prism. If a ray of light DE (*fig. 21.*) fall obliquely out of air on a prism ABC ; being refracted towards the perpendicular, instead of proceeding to F , it will decline to G , *i. e.* towards a line HI , drawn perpendicular to the surface AB in the point of refraction E . Again, since the ray EG , passing out of the glass into air, falls obliquely on CB , it will be refracted to M , so as to recede from the perpendicular NGO . And hence arise the various phenomena of the prism. See COLOUR and REFRACTIBILITY.

REFRACTION in a convex lens. If parallel rays, AB, CD , and EF (*fig. 22.*) fall on the surface of a lens $2B3K$, the perpendicular ray AB will pass unrefracted to K , where emerging into air perpendicular, as before, it will proceed straight to G . But the rays CD and EF , falling obliquely out of air into glass, in D and F , will be refracted towards the axis of refraction (*i. e.* towards lines HI and LM , drawn perpendicular to the refracting surface in the points of refraction D and F) and decline to Q and P . Again, emerging obliquely out of the glass into the surface of the air, they will be refracted from the perpendicular, and, therefore, DQ will not proceed to X , but to G ; and FP , not to V , but to G ; thus, likewise, might all the other rays, falling on

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the surface of the glass, be shewn to be refracted so as to meet the rest about the point G. See FOCUS and LENS.

Hence the great property of convex glasses; *viz.* that they collect parallel rays, or make them converge into a point.

REFRACTION in a concave lens. Parallel rays A B, C D, and E F (*fig.* 23.) falling on a concave lens G B H I M K, the ray A B, falling perpendicular on the glass at B, will pass unrefracted to M; where being still perpendicular, it will pass into the air without refraction, to L. But the ray C D, falling obliquely on the surface of the glass, will be refracted towards the perpendicular N D O, and proceed to Q; and the ray D Q, again falling obliquely out of the glass upon the surface of air, will be refracted from the perpendicular R Q S, and proceed to V. After the same manner might the ray E F be shewn to be refracted to Y, and thence to Z.

Hence the great property of concave glasses; *viz.* that they disperse parallel rays, or make them diverge. See LENS and MIRROR.

REFRACTION in a plane glass. If parallel rays E F, G H, I L (*fig.* 24.) fall obliquely on a plane glass A B C D, the obliquity being the same in all, by reason of their parallelism, they will be all equally refracted towards the perpendicular; and accordingly, being still parallel at M, O, and Q, they will pass out into the air equally refracted again from the perpendicular, and still parallel.

Thus will the rays E F, G H, and I L, at their entering the glass, be inflected towards the right; and in their going out as much inflected to the left; so that the first refraction is here undone by the second; though not so as that the object is seen in its true place. For the ray B Q, being produced back again, will not coincide with the ray L I, but will fall to the right of it; and this the more as the glass is thicker; however, as to matter of colour, the second refraction does really undo the first. See COLOUR.

REFRACTION of Heat. See HEAT, LIGHT, and RAYS of Heat.

REFRACTION in Iceland or Island crystal. See ICELAND CRYSTAL. Dr. Young, who maintains that radiant light consists in undulations of the luminiferous ether, takes occasion to make some remarks on sir Isaac Newton's theory of the peculiar refraction in Iceland crystal. Newton, he says, has advanced the singular refraction of the Iceland crystal, as an argument that the particles of light must be projected corpuscles; since he thinks it probable that the different sides of these particles are differently attracted by the crystal, and since Huygens has confessed his inability to account, in a satisfactory manner, for all the phenomena. But contrarily to what might have been expected from Newton's usual accuracy and candour, he has laid down a new law for the refraction, without giving a reason for rejecting that of Huygens, which Mr. Haüy has found to be more accurate than Newton's; and, without attempting to deduce from his own system any explanation of the more universal and striking effects of doubling spars, he has omitted to observe, that Huygens's most elegant and ingenious theory perfectly accords with these general effects, in all particulars, and of course derives from them additional pretensions to truth; this he omits, in order to point out a difficulty for which only a verbal solution can be found in his own theory, and which will probably long remain unexplained by any other.

Dr. Wollaston, in his paper on the oblique refraction of Iceland crystal, confirms the experiments of Huygens on this substance, with additional evidence, deduced from the superiority of his mode of examining the powers of refraction. He observes that Dr. Young has already applied

the Huygenian theory with considerable success to the explanation of several other optical phenomena, and that it appears to be strongly supported by such a coincidence of the calculations deduced from it, with the results of these experiments, as could have scarcely happened to a false theory.

In ordinary cases, the incipient undulations are of a spherical form; but in the Iceland crystal light appeared to Huygens to proceed as if the undulations were portions of an oblate spheroid, of which the axis is parallel to the short diagonal of an equilateral piece of the crystal, and its centre the point of incidence of its ray. From this spheroidal form of the undulations, he deduces the obliquity of refraction; and lays down a law observable in all refractions, at any surface of the spar, whether natural or artificial, which bears the closest analogy to that which obtains, universally, at other refractory surfaces; for as, in other cases, the ratio is given between the sine of incidence and sine of refraction, (or ordinate of the spherical undulation propagated,) so in the Iceland crystal, the ratio between the sine of incidence and ordinate of refraction (in any one section of the spheroidal undulation) is in a given ratio, but different in different planes.

Dr. Wollaston observes, that though we do not fully understand the existence of a double refraction, and are utterly at a loss to account for the phenomena occurring upon a second refraction, by another piece of the spar, yet that the oblique refraction, when considered alone, is nearly as well explained as any other optical phenomenon. *Phil. Trans.* for 1801 and for 1802.

REFRACTION, Particular laws of, in different kinds of lenses; see LENS.

REFRACTION, Atmospheric, is generally considered under two distinct heads; *viz.* astronomical refraction, which is that relating to the refraction of the moon, stars, and other celestial bodies; and terrestrial refraction, or that which takes place in terrestrial observations.

It appears, from the article REFRACTION, that a ray of light is refracted in passing obliquely out of one medium into another of different density; and as the atmosphere may be considered as composed of an infinitude of strata, whose density increase as they are posited nearer the earth, the luminous rays which pass through it are acted on as if they passed successively through media of increasing density, and are therefore inflected more and more towards the earth, as the density augments, that is, as they approach the eye of the observer. In consequence of this it is, that rays from objects, whether celestial or terrestrial, proceed in curves which are concave towards the earth; and since the mind always refers the place of objects to the direction in which the rays reach the eye, that is, to the direction of the tangent to the curve at that point, it follows, that the apparent or observed elevation of objects is always greater than the true one, at least with the exception of some few remarkable anomalies which sometimes, in terrestrial observations, produce a contrary effect, and of which we have stated a few particular instances under the article MIRAGE, and on which subject some other curious facts are recorded in a memoir of professor Vince's, in the *Phil. Trans.*; in Nicholson's *Philosophical Journal*, 4to.; and more particularly by M. Monge, in vol. i. of the "*Decade Egyptienne*." Referring the reader therefore to those works, to which we ought also to add the memoir by M. Biot, in vol. x. of the *National Institute*, for an account and explanation of those phenomena, we shall confine our present observations to those cases only, in which an uniform law is supposed to have place, and which, as we have seen, has a constant tendency to augment the observed altitude of both terrestrial and celestial objects.

objects. In order to submit the phenomena of refraction to strict mathematical investigation, it must be observed that, in consequence of the inconsiderable height of the atmosphere, and its spherical form, a luminous ray impinging upon it, even in the most unfavourable case, that is directly in the horizon, traverses only a small quantity of this medium; and in this space, if the atmosphere is calm, the density of the air at equal heights above the level of the sea is every where the same. Therefore, in supposing the earth spherical, a supposition which may be admitted, in the present case, without any sensible error, we may consider the atmosphere as composed of successive spherical concentric shells, or strata, of which the density diminishes from the surface of the earth upwards.

Let us conceive, now, a luminous ray, coming from a distance, to penetrate into one of the supposed spherical shells; then, if through the common centre of these shells, which is the same as the centre of the earth, we suppose a plane to pass in the direction of the luminous ray, the spherical beds of the atmosphere will be found divided into two equal portions, which acting equally upon the ray, can produce no deviation of it from that plane; whence it follows, that the effect of refraction is entirely produced in a vertical direction, and in such a manner as to augment the apparent altitudes of the heavenly bodies, and consequently to diminish their zenith distances.

But the intensity of these effects will not be the same at all heights, for we know that in all cases the quantity of refraction depends upon the obliquity of incidence, and therefore the refraction in the zenith is equal to zero, and increases from that point to the horizon, where it is the greatest.

If, now, we knew the law by which the density of the air is diminished in ascending from the earth, that is, if we knew the difference in the density of any two consecutive strata, it would be comparatively a direct and easy problem to find the whole amount of refraction for any given angle of observation; but unfortunately the uniformity of decrease in the density of the atmosphere, which, according to theory, is in geometrical progression, is so much interrupted by the multitude of causes which may tend to produce this effect, that it is found that the quantity of refraction computed on this principle, will by no means agree with that deduced from actual observation. It has been, however, demonstrated, that the quantity of refraction, in all cases exceeding 10 or 12 degrees of elevation, is not sensibly affected by any irregularity in the law of density, in the strata of which we have supposed the atmosphere to be composed, but that it depends simply upon its pressure and temperature at the time and place of observation, which are indicated at the time by the barometer and thermometer. It was formerly thought, also, that refraction was influenced by the degree of humidity and dryness of the air; but from a great variety of interesting and accurate experiments, carried on by M. M. Biot and Arrago, it appears indisputably established, that no sensible effect is thence produced. See a memoir on this subject by the former author, in vol. x. of the National Institute.

But before we proceed farther on this interesting subject, it will be proper to give a sketch of the several improvements which the theory has experienced in the hands of different celebrated astronomers; in doing which we shall avail ourselves of a memoir, published by Dr. T. S. Evans in the Philosophical Magazine, which contains a minute and circumstantial detail of many important particulars connected with this subject. There appears to be but little doubt

that the astronomic refraction was known to the ancients, since it is expressly mentioned by Ptolemy, although not made use of in his calculations. He says, near the end of the 8th book of the *Almagest*, that in the rising and setting of the heavenly bodies, there are changes which depend upon the atmosphere, and he mentions it more at length in a work on optics, which, unfortunately, has not been handed down to us. Alhazen, an Arabian writer, who is generally supposed to have lived about the year 1100, and to have taken the greater part of his optics from the works of Ptolemy, speaks also decidedly of it, and shews the manner of convincing ourselves of it by experiment. "Take," says he, "an armillary, which turns round its poles, and measure the distance of a star from the pole of the world when it passes near the zenith in the meridian, and when it is rising or setting near the horizon, and you will find the distance from the pole less in the latter case." He then demonstrates that this must arise from refraction, but he does not state its quantity.

In the collection of observations made by Bernard Walter, and published by Willebrode Snell in 1618, it is stated, that the observations were so exact, that they pointed out to Walter the quantities by which the altitudes of the stars and planets were increased on account of the refraction.

Tycho Brahe, however, appears to be the first who asserted, with any degree of accuracy, that the refraction elevates the heavenly bodies rather more than half a degree when on the horizon. (See *Progymn.* p. 15.) But either his instruments or his observations were not sufficiently correct to determine it with certainty for all degrees from the zenith to the horizon; and, accordingly, where these failed, the rest were supplied by conjecture. He believed that the sun's refraction was 34' in the horizon, and that it became insensible at 45° of altitude. For the stars, however, he assumed an entirely different quantity, *viz.* 30' in the horizon; but this, according to him, terminated at only 20° of altitude.

The following is the manner in which it is related (*Encyc. Method.*) that Tycho made this discovery. He had determined, with one or two instruments extremely well made, the latitude of the place by observations of Polaris above and below the pole. He determined it also by the sun's altitude in both solstices, and found it four minutes less in the latter. At first he doubted the goodness of his instruments, and therefore constructed, with the utmost care, as many as ten others, of different sizes and forms, but they all gave nearly the same results. He could, therefore, no longer attribute this difference in the two determinations of the latitude to any defect in the observations, but endeavoured, by an attentive consideration of the subject, to find out the cause of this singular phenomenon. At length he supposed it could only arise from the refraction which elevated the sun at the winter solstice, having then only 11° of elevation above the horizon. This result agreed very well with the principles of optics; but still Tycho Brahe could scarcely persuade himself that the refraction was sufficiently large to produce so great a difference. On this account, he made other instruments of ten feet diameter, whose axes corresponded exactly with the pole of the world, and with these he measured the declination of the stars out of the meridian. He then found, that even in summer the refraction, although insensible at the meridian altitude of the sun, was very considerable near the horizon, and amounted to half a degree in the horizon. See *Progymn.* p. 79—104. *Street's Astr. Carol.* p. 119.

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Tycho Brahe's table of refraction is as follows :

Alt.	Refraction.		Alt.	Refraction.	
0°	30'	0"	0	1	"
1	21	30	11	5	00
2	15	30	12	4	30
3	12	30	13	4	00
4	11	00	14	3	30
5	10	00	15	3	00
6	9	00	16	2	30
7	8	15	17	2	00
8	6	45	18	1	15
9	6	00	19	0	30
10	5	30	20	0	00

In this state the refraction remained for many years. Even Riccioli, in 1665, supposed it nothing at about 26° of altitude; but he thought the moon had only 29' of horizontal refraction in summer, the sun 30', and the stars 30' 37". It was not till after the year 1672, that a tolerably near table of refraction made its appearance, when the elder Cassini took the subject into consideration. (Mem. de l'Acad. tom. v. p. 81.) What led to this was the voyage of Richer to Cayenne in that year, upon the utility of which some very excellent remarks were made by Cassini, shewing how far observations made in a situation so near the equator tended to confirm or disprove certain theories derived from observations made in Europe. Several very useful deductions were drawn from a comparison of those made both at Paris and Cayenne; among others, the refraction was settled upon more accurate elements than heretofore, and a new table computed, for the first time, of its quantity, for all degrees, up to the zenith; an abridgment of which is given below :

Alt.	Refraction.		Alt.	Refraction.	
0°	32'	20"	0	1	"
1	27	56	30	1	42
2	21	04	40	1	10
3	16	06	45	0	59
4	12	48	50	0	50
5	10	32	60	0	34
10	5	28	70	0	21
15	3	36	80	0	10
20	2	39			

From the relation of his grandson it appears, however, that Cassini had at one time computed three tables of refraction for all altitudes; one for winter, another for summer, and a third for spring and autumn; but several doubts having been suggested to him respecting this arrangement, although in appearance conformable to nature, and principally the observations of Richer at Cayenne, where the refraction was found little different from that at Paris, he changed his opinion; and judging, that since the great difference of heat of the torrid zone from that of the temperate zone, which we inhabit, does not cause sensible differences in the refraction; therefore the greatest heat or cold of our climate could not change it much; and he then fixed upon one table, which was that used by the astronomers of the Royal Observatory of Paris up to the year

1745.

It was always thought, before the time of Cassini, that the refraction did not extend its influence higher than 45° of altitude: and he is generally considered as the first who proved that it reached all the way to the zenith. He also supposed that near the equator the horizontal refraction was less than in our climate by about one-third; that this difference decreased as far up as 60°, after which it was the same nearly for both climates.

From this discovery it followed, as a natural consequence, that the refraction must be greater near the pole than at Paris: and this was shortly afterwards proved to the Academy by the publication of a work expressly on that subject. (*Refractio solis inoccidui*, &c. Holmiz, 4to. 1695.) The king of Sweden, being, in 1694, at Tornea, in West Bothnia, near the latitude of 65° 45', and observing that the sun did not set there in the summer solstice, sent the following year some mathematicians to make more certain and exact observations of this curious phenomenon. They are contained in this book, and Messrs. Cassini and De la Hire concluded from them, that in the latitude of 65° 45' the horizontal refraction must be 58', or nearly double of that at Paris.

According to an observation made by some Dutchmen who passed the winter of 1596-7, in Nova Zembla, in latitude 76° north, the sun, which had entirely disappeared the 14th of November, began to rise again the 24th of January, viz. six days sooner than was expected, according to astronomical calculations. If so, when the sun has been two or three months under the horizon, as the Dutchmen observed in 1597, the cold becomes dreadful, and perhaps the refraction increases prodigiously. M. le Monnier assures us, that he found by the observations printed in 1599, that on the 24th and 27th of January 1597, there were more than 4½ degrees of refraction: that he could neither explain these observations, reject them as doubtful, nor suppose any error, as was done by most of the other astronomers, Kepler, Cassini, Scotto, and, lastly, M. le Gentil, in his *Voy. dans les Mers des Indes*, tom. i. p. 395. tom. ii. p. 832, who maintained that there were errors in the observations, and accordingly read a memoir on the subject. If it were not so difficult a task to winter in these high latitudes, we might expect such observations as would remove all doubt on the subject; and, perhaps, bring others to light of as great or greater importance.

The refraction of the north being so considerable, is very useful to the inhabitants, who are deprived of the sun's light during many months; as it makes the sun rise much earlier, and set much later to them, than it otherwise would.

About the year 1725, Mr. Flamsteed, the English astronomer royal, published his table computed from his own observations: and this was the one commonly used in England for many years afterwards.

Sir Isaac Newton also constructed one from theory, which was first published by Dr. Halley in the *Philosophical Transactions*, N° 368, for 1721. He made the horizontal refraction 33' 45"; whereas Mr. Flamsteed's was only 33' 0".

But although the refraction might be determined within a few seconds at all altitudes by observation; yet, the law of its increase from the zenith to the horizon was a subject that occupied the principal mathematicians and astronomers for more than a century. Newton having discovered the general principles of attraction, found that the refraction was a consequence of this law of nature; and that it arose from the attraction of the atmosphere on the particles of light. On this principle the curve which a ray of light describes might be determined; since it is successively attracted

tracted by different layers of the atmosphere, increasing in density as they approach the earth, and, consequently, bending the ray more and more from the right line which it described in the vacuum previous to its reaching the atmosphere. There are many authors who have endeavoured to find from theory the curve described by this ray in its course, by the assumption of various hypotheses; but perfection, and our attempts to arrive at it, as is well observed by the elder Cassini in discoursing on this subject, are like the progress of certain curves and their asymptotes. The principal of these writers on the subject are Bernoulli (*Hydrodyn.* 1738, p. 221.); Boscovich (*Oper.* tom. ii.); Bouguer (*Prix de 1729. Memoires*, 1739, p. 407; 1749, p. 75.); Cassini (*Epist. ad Montanari*, 1665. *Refractioni e Parabolis*, &c. 1671. *Mem. for 1714*, and his *Astr.* vol. i. p. 11. Paris, 1740, in 2 vols. 4to.); Descartes (*Dioptrique*, 4to. Paris, 1637); De la Grange (*Nouveaux Memoires de Berlin*, vol. iii.); Euler (*Mem. de Berlin*, 1754, tom. x.); Gregory (*Astronomy*, vol. i. p. 358. edit. of 1715, in 8vo.); Hodgson (*Mathematics*, vol. i. p. 367. *Fluxions*, p. 133.); Huygens (*Traité de la Lumiere*, p. 44. *Dioptrica*, 4to. 1703); Kramp (*Analyse des Refract. Astr. et Terres*, 4to. Strasbourg, 1799); Lambert (*Les Propriétés Remarquables de la Route de la Lumiere*. A la Haye, 1759. Another edition in German, 1773); La Place (*Mécanique Céleste*, vol. iv. p. 231.); Mayer (*Tables*, 1770); Newton (*Principia*, b. i. sect. 14.); Oriani (*Ephem. de Milan*, 1788); Thomas Simpson (*Mathematical Dissertations*, 1743); Brook Taylor (*Methodus Incrementorum*, 4to. Lond. 1715. *Propos.* 27. p. 108.); Heinsius (*Dissertatio de Computo refractionum Astron.* 4to. Leipzig, 1749); Tobias Mayer (*De Refractionibus Astronomicis*, 4to. Altorf. 1781); La Hire (*Mem. de l'Acad. pour 1702*, p. 52.); d'Alembert (*Opusculs Mathématiques*, tom. viii. p. 297.)

It was conjectured by many of the early writers, that the refraction was subject to variations depending upon the weather: but it then amounted to little more than a conjecture, on account of the indifferent manner in which astronomical instruments were divided. Picard found by meridian altitudes of the sun in 1669, that it was greater in winter than in summer. He found also that it was less by day than by night. In the observations given at the end of his journey to Uraniburg, to settle the latitude of that place, and its difference of longitude from Paris, for the purpose of comparing the observations of Tycho Brahe with those made at the Royal Observatory of Paris, he found the horizontal refraction for the first limb of the sun that made its appearance above the horizon there $33' 2''$, and for the second $32' 37''$. So that in the small interval of time that the sun was in rising, the refraction was diminished 25 seconds by the warmth arising from the sun's presence.

A quadrant being also directed by him from the top of Mount Valerian towards the summit of the church of Notre Dame at Paris, he found the depression $20'$; but the sun had scarcely risen, when it was increased to $22'$; exhalations being raised by the sun's presence, and the medium between Paris and Mount Valerian become more equal; whereas, before the sun rose, the air of Paris was more dense than that of Mount Valerian.

The density of the atmosphere being the immediate cause of the refraction, it was very natural to suppose that it must decrease as this density became less; whether by causes which diminished its weight, or by the expansion produced by heat: and, indeed, astronomers were not long after this, before they discovered that very sensible differences were occasioned by these circumstances.

But all the honour of introducing corrections on account

of the variation of density in the atmosphere, as indicated by the barometer and thermometer, is due to Messrs. Lowthorpe and Hauksbee; the former of whom, in 1698, proved by a very simple experiment, in the presence of the Royal Society, that the refractive power of air is directly proportional to its density: and the latter, by repeating and extending the same course of experiments in the year 1708, with the machinery pointed out by the former, found that the variations of refraction, depending on the barometer, are proportional to the alteration of height of the mercury in the tube: and by a series of these experiments, he furnished us with a table of the corrections which it is necessary to make on account of the changes of heat indicated by the thermometer. These experiments, although not quite conclusive on the subject, were yet made with as much accuracy and care as the nature of the machinery, and the state of experimental philosophy of that time, would admit. An example is also given, towards the end of his paper, on the mode of applying them to correct the refraction. By these, Hauksbee found that a volume of air expressed by unity, when the thermometer was at 180° above zero, became, at 50° below, one-eighth more dense: or, which is the same thing, that the air lost one-eighth of its density, for an elevation of 180° of Fahrenheit's thermometer; which is exactly the difference of heat between melting ice and boiling water. But although this one-eighth, as will be shewn hereafter, was too small; yet it laid the foundation for other experiments, since made by several philosophers, by which the quantity of expansion has been determined more accurately.

We have already shewn that the refraction near the pole is greater than in our climate; the degree of cold being more intense. It was also found to be less in the torrid zone, where the heat is greater than in Europe. Bouguer made a variety of observations at Peru, the result of which he has given us. In 1740, he came down into an island situated in the river of Emeralds, called *isla de Inca*, where he determined the refraction from 1° to 7° of altitude; and the table which he afterwards computed shews the refraction to be about one-seventh less than in Europe. The horizontal refraction he found to be $27'$: but at 6° of altitude it is $7' 4''$; and at 45° , it is $44''$. Bouguer then gives a table for Quito, which is more elevated above the level of the sea. M. le Gentil found it greater at Pondicherry in India, although in the torrid zone.

The refraction diminishes when we are elevated above the level of the sea. Bouguer observed the quantity of it at Chimborazo, 2388 toises above the level of the sea, and found it in the horizon only $19\frac{3}{4}'$. At the cross of Pitcinca, 2044 toises above the sea, he found it $20' 48''$; at Quito, 1479 toises above the sea, $22' 50''$: but at the level of the sea $27'$. These observations, when joined with the theory, produced the following rule; *viz.* if we take the excess of 5158 toises above the elevation of the place, with regard to the level of the sea, the refraction will be as the square root of this excess. Thus the square root of 5158 toises is $27'$, for the horizontal refraction, at the level of the sea, in the torrid zone: and the square root of the excess of 5158 above the elevation of the place will be its horizontal refraction. The quantity 5158 is the height above which the refractive matter no longer produces any sensible effect, at least in the torrid zone.

But although by this time considerable attention had been paid to the subject, yet great differences were to be found in the tables then most in use. Thus at the altitude of 30° , according to Flamsteed, the refraction was $1' 23''$; Newton, $1' 30''$; Cassini, $1' 42''$; and de la Hire, $1' 55''$; leaving an uncertainty of more than half a minute: and it must have been very mortifying to an observer, after having taken the utmost

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utmost pains to avoid errors of two or three seconds, to find his reduced observations liable to so great an error, according to the choice of his table of refraction.

It is indeed rather extraordinary, that in a memoir published by Cassini de Thury, among those of the Academy for 1745, he attempted to reconcile a number of observations with each other, by considering the state of the thermometer only, without at all noticing that of the barometer; although at that time Hauksbee's experiments had been published about 37 years.

He concludes his paper, as is very natural to suppose, without being able to make the observations agree: nor does it clearly appear that the French noticed the above-mentioned experiments made by Hauksbee till about the year 1749. It is also worthy of remark, that although the necessity of introducing corrections on account of the alterations of the barometer and thermometer were likewise shewn to be absolutely necessary by Dr. Halley (Phil. Trans. N° 364), and the circumstance mentioned, and in some degree admitted by Le Monnier (Hist. Celest.), yet it does not appear that he followed the advice of his illustrious contemporary, but merely endeavoured, as Cassini did, to reconcile his observations with the state of the thermometer at the time of making these observations, without taking the barometer into account.

It would be endless to notice the different opinions respecting both the terrestrial and the astronomic refraction which are to be met with in the writings of various authors on the subject: and it would be equally useless to notice all the tables of its quantity given by them, some of which differ very much from others. It will be sufficient to mention those only who made some considerable advances towards obtaining it with greater accuracy.

The next of these in order was La Caille (Mem. de l'Ac. de Sc. 1755, p. 547.), who in determining it certainly bestowed very great pains, by making and reducing an immense number of observations, and afterwards comparing them with others made at Greenwich by Dr. Bradley, at Gottingen by Mayer, at Bologna by Zanotti, and by La Lande, who was then at Berlin. From these it appeared that the refraction at 45° of altitude was $1' 6\frac{1}{2}''$; but this, as will hereafter be seen, was too great by some seconds. In his paper on the subject, which is divided into four parts, he proves, first, that the mean refractions are very nearly the same for the same apparent altitudes throughout the whole extent of the temperate zone; since those which were observed at Paris did not exceed those observed at the Cape of Good Hope but by $\frac{1}{4}''$ at most. In the second he determines the absolute quantity of the mean refraction for the apparent height of the pole at Paris, and gives the result of his observations with regard to the latitude of Paris and of the Cape of Good Hope. In the third he gives his table of mean refraction, and another of corrections depending upon the state of the barometer and thermometer; concluding with some reflections on its construction and use. In the fourth he compares his new table with the most celebrated of those that had before that time been in use among astronomers; and he then shews how it agrees with the observations of Bradley, Zanotti, and Mayer.

But by La Caille's memoir it appears, that previous to this time M. Mayer had formed and communicated to him a table of astronomic refractions which he computed by means of an algebraic formula, the co-efficients of which he deduced from his own observations, and took into account the variations relative to those of the barometer and thermometer. He found the alteration of refraction for a depression of 15 lines in the barometer, the same as for a rise of 10° in the thermometer, and the variation for each degree of

the latter, according to his table, $\frac{1}{4}''$ of the whole mean refraction, which he adapted for 28 inches of the barometer, and 0° of the thermometer. This proportion takes place down to 80° of zenith distance. Mayer considered also that the mean refraction is the same for all parts of the earth; and that the only variation which takes place depends on the changes of the weight and temperature of the atmosphere.

La Caille, in comparing Mayer's table with observations, found that his correction for the thermometer was a little over-rated; and accordingly, for his new table, altered it to $\frac{1}{4}''$ for each degree. And here it may be observed that La Caille did not correct his altitudes above 36° at Paris, and 30° at the Cape; first, because he only noted the barometer and thermometer in the night, when he observed stars below 30° of altitude. Secondly, because, that at 36° of altitude, where the mean refraction is about $1\frac{1}{2}$ minute, the variation which belongs to 10° of the thermometer only amounts to $3\frac{1}{2}$ seconds; a quantity about equal to the limits of the errors of observations made with an instrument of six feet.

The formula given by Euler (Mem. de l'Ac. de Berlin, 1754, p. 131.), appeared also about this time. It took into account the variation of the refraction depending upon the thermometer and barometer, but was certainly too complicated to be generally adopted. He shews, however, that in very different hypotheses the refraction will be sufficiently exact, if taken in the inverse ratio of the degrees of heat, when the star or planet is not too near the horizon, but the precise quantity of this ratio was unknown to him.

In this state the refraction stood when Dr. Bradley took the subject into consideration, and began to find its quantity from his own observations. The rule which he adopted, although a very elegant one, he neither lived to complete nor to present to the world; but it was published after his death by Dr. Maskelyne, (Pref. to 1st vol. of Obs. 1765. Phil. Trans. 1764 and 1787, p. 157. Req. Tables, &c.), and has commonly been used in England up to the present time. He found the mean refraction at 45° of altitude 57'', and, that at all other altitudes, it was equal to 57'' multiplied by the tangent of the zenith distance, diminished by three times the refraction. Then supposing the mean state of the atmosphere to be at 29.6 inches of the barometer, and 50° of Fahrenheit's thermometer, he made the true or corrected refraction equal to $57'' \times t$, (Z. D. - 3 r)

$$\times \frac{\text{barom.}}{29.6} \times \frac{400}{350 + \text{ther.}}, \text{ where it is to be understood}$$

that the mass of air is supposed to increase in bulk $\frac{1}{350}$ for each degree of Fahrenheit's scale.

A variety of experiments has been made at various times to ascertain the increase in bulk of a quantity of air represented by unity for a certain number of degrees of rise of the thermometer. The following is a list of some of them:

	for 1°
M. Bonne	1.00 25777
Bradley	1.00 25000
Dalton	1.00 20701
De Luc	1.00 20888
Fahrenheit	1.00 25777
Gay Lussac	1.00 20868
Groombridge	1.00 21000
Hauksbee	1.00 06933
La Caille	1.00 22222
Mayer	1.00 20444
Shuckburg	1.00 22222
Mean of all except Hauksbee's	1.00 22490

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The refraction deduced from Bradley's very neat and simple formula was, in a few years, adopted by nearly all the astronomers of eminence throughout Europe. The extreme facility with which it might be computed, and the corrections applied, whether from the formula itself, or from tables ready calculated for that purpose, was a powerful recommendation in its favour; but its near agreement with observation soon established it.

We must now, without entering farther into detail of minor improvements, proceed at once to the chapter given by La Place on this subject, in his "Mecanique Celeste," vol. iv. p. 231, where he has drawn, from an investigation which we cannot undertake to exhibit in this place, the following general formula, for expressing the refraction for all angles of elevation above 12 decimal, or 10.8 sexagesimal degrees, viz.

$$r = \frac{a p \cdot \tan. z}{0.76 (1 + t \cdot 0.00375)} - \frac{a p}{0.76} \cdot 0.00125254 \frac{\tan. z}{\text{cof.}^2 z} + \frac{\frac{1}{2} a' \sin. 1'' p'}{[0.76 (1 + t \cdot 0.00375)]^2} \times \frac{(1 + 2 \text{cof.}^2 z) \tan. z}{\text{cof.}^2 z};$$

where all the quantities are known except r and a ; which latter represents a constant co-efficient; viz. z is the observed zenith distance under the barometric pressure p , in metres, and t the temperature of the centigrade thermometer, r being the refraction: all, therefore, that is required for determining r , is the value of the unknown co-efficient a ; which is to be drawn from observations on the circumpolar stars, in the following manner.

Let Z be the distance of one of these stars from the zenith, in its superior meridian passage; Z' , this distance at the inferior meridian passage, observed from the same point of the terrestrial surface; r and r' , the corresponding refractions. Now all the other quantities, except a , being known, we may, for the sake of simplicity, put the above formula for both passages under this form,

$$r = Aa + Ba^2, \quad r' = A'a + B'a^2;$$

where A , B , A' , B' , are all known quantities. Writing also Z , Z' , for the observed zenith distances, the true zenith distance, D , corrected for refraction, will be

$$Z + Aa + Ba^2, \quad \text{and} \quad Z' + A'a + B'a^2,$$

which are, therefore, now equal to each other; consequently, by addition, we have

$$Z + Z' + (A + A')a + (B + B')a^2 = 2D;$$

in which all the quantities are known, except a and D . But by repeating similar observations on some other star, and denoting by Z'' , Z''' , A'' , A''' , B'' , and B''' , the similar quantities before represented by Z , Z' , A , A' , &c. also a and D remaining the same for all stars observed in the same place, we shall have these two equations:

$$Z + Z' + (A + A')a + (B + B')a^2 = 2D, \\ Z'' + Z''' + (A'' + A''')a + (B'' + B''')a^2 = 2D;$$

from which it is obvious, the constant co-efficient a may be obtained by the usual methods of elimination.

In the above operation, however, we have supposed the polar distances of the same star to be the same for its superior and inferior passage; whereas we know that, in consequence of the effect of precession, nutation, and aberration, this distance is constantly varying; and we ought, therefore, to introduce these variations into the above equation. But our object being merely to give a general view of the principles made use of for the determination of the

co-efficient a , we have not thought it necessary to enter so strictly into the minutia of the computation. It appears from the above, that the constant co-efficient a may be determined by means of four observations on two different circumpolar stars; and consequently, that every such set of observations ought to produce the same result, or the same value of a . Considering, however, the extreme accuracy required in such cases, both in the instruments and the application of them, some little disagreement is to be expected; and indeed one is surprised to see it so small, as it has been found to be in various observations undertaken for this purpose, and the mean of which we have every reason to consider as perfectly correct; and which is stated by M. Biot, who has interested himself very much on this subject, at $187''.24$ for the decimal division, or $60''.666$ for the sexagesimal.

But now, in order to simplify our first formula, by taking $p = 0.76$ metres, and $t = 0$, this may be put under the form,

$$r = a \tan. Z \left(1 - \frac{0.00125254}{\text{cof.}^2 z}\right) + \frac{\frac{1}{2} a' \sin. 1''}{\text{cof.}^2 z} \frac{1 + 2 \text{cof.}^2 z}{\tan. Z};$$

in which, substituting for $\text{cof.}^2 z$, its value $\frac{1}{1 + \tan.^2 z}$, and the proper numerical value of a , as above found, as also of $\sin. 1''$, the whole is reduced to the following form, viz.

$$r = 0.99918761 \cdot a \tan. Z - 0.001105823 \cdot a \tan.^3 Z;$$

which latter form M. Biot has shewn to be equivalent to

$$r = 187''.24 \cdot \tan. (Z - 3.25 r) \text{ for the decimal division; } \\ r = 60''.666 \cdot \tan. (Z - 3.25 r) \text{ for the sexagesimal division.}$$

But the reduction of it to this form would occupy more space than can be allowed for this article. This last form is as simple as can be desired, from which the following rule in words may be deduced, viz. *The refraction under the same barometric pressure, and the same degree of temperature, is proportional to the tangent of the apparent zenith distance of the star, diminished by $3\frac{1}{4}$ times the refraction.*

It must be remarked, however, that the formula $r = A \tan. (Z - 3.25 r)$, though it exhibits the law of refraction in as simple a form as can be desired, is not well adapted for calculation, in consequence of r entering on both sides of the equation; and astronomers have, therefore, given different methods of rendering the above formula more commodious. In order to which, it is first put under the form,

$$\tan. nr = \tan.^2 n R \tan. (Z - nr);$$

R representing the refraction, answering to $Z = 90^\circ$. Let us now add successively to both sides of this equation, the quantities $+\tan. nr \tan.^2 n R - \tan. nr \tan.^2 n R$, and we shall have,

$$\tan. nr (1 + \tan.^2 n R) = \tan.^2 n R [\tan. (Z - nr) + \tan. nr], \\ \tan. nr (1 - \tan.^2 n R) = \tan.^2 n R [\tan. (Z - nr) - \tan. nr].$$

Now, dividing these equations, member by member, nr will be eliminated, and we obtain

$$\frac{1 + \tan.^2 n R}{1 - \tan.^2 n R} = \frac{\tan. (Z - nr) + \tan. nr}{\tan. (Z - nr) - \tan. nr},$$

$$\text{or } \frac{1}{\text{cof.}^2 n R} = \frac{\sin. Z}{\sin. (Z - 2nr)};$$

whence we draw

$$\sin. (Z - 2nr) = \text{cof.}^2 n R \cdot \sin. Z.$$

Now

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Now Z and nR being known, we may compute the second side of this equation; whence the arc $Z - 2nr$ is known, and consequently $2nr$; which, divided by $2n$, will give r , as required. But it may be found still more simply by the formula,

$$\tan. nr = \tan. nR \tan. \frac{1}{2} n;$$

$\tan. n$ being found by means of the auxiliary equation,

$$\tan. u = \sin.^2 nR \cdot \tan. Z.$$

On the principle above explained, the following table of refractions has been computed, agreeing with the temperature of $+14^\circ$ on the centigrade thermometer, and under a pressure of 0.76 metres of the barometer; which is the same as $57^\circ.2$ Fahrenheit, and 29.922 English inches. And for any other temperature and pressure, the corresponding corrections must be made as indicated in Tables II. and III.; which tables are computed by means of the general formula given in the preceding part of this article.

We had intended to give here a short abstract of a very interesting paper on this subject, published by Mr. Groombridge, in the Philosophical Transactions for 1810; but having already exceeded our usual limits, we can only refer the reader to the volume itself, where he will find several neat and useful formulae.

Having thus given a sketch of the method of determining the quantity of astronomical refraction for all angles of elevation, and under various degrees of temperature and barometric pressure, let us add a few words on the subject of terrestrial or horizontal refraction; for the determination of which, the following method has been successfully practised in the English Trigonometrical Survey.

Let A, A' , (*Plate XIX. Astronomy, fig. 11.*) be two elevated places on the surface of the earth; BD , the intercepted arc of the earth's surface; C , the centre of the earth; $AH, A'H$, the horizontal lines at A, A' , produced to meet the opposite vertical lines CH, CH' . Let a, a' , represent the apparent places of the objects A, A' ; then is $a'A$ the refraction observed at A , and $a'A'$ the refraction observed at A' ; and half the sum of these angles will be the horizontal refraction, if we assume it equal at each station.

Now an instrument being placed at each of these stations A, A' , the reciprocal observations are made at the same instant of time, which is determined by means of signals or watches previously regulated for that purpose; that is, the observer at A takes the apparent depression of A' , at the

same moment that the other observer takes the apparent depression of A . Then, in the quadrilateral $ACA'I$, the two angles A, A' , are right angles, and consequently the angles I and C are together equal to two right angles; but the three angles of the triangle IAA' , are together equal to two right angles; and consequently the angles A and A' are together equal to the angle C , which is measured by the arc BD . If, therefore, the sum of the two depressions $HA'a, H'A'a$, be taken from the sum of the angles $HA'A, H'A'A'$, or, which is equivalent, from the angle C , (which is known, because its measure BD is known,) the remainder is the sum of the two refractions. Hence this rule, "take the sum of the two depressions from the measure of the intercepted terrestrial arc, half the remainder is the refraction." If, by reason of the minuteness of the contained arc BD , one of the objects, instead of being depressed below the tangent AH' , appears elevated, as suppose A to a'' , then the sum of the angles $a''AA'$, and $a'A'A$, will be greater than the sum $IAA' + I'A'A$, or than C ; by the angle of elevation $a''AA'$; but if from the former sum there be taken the depression $HA'A$, there will remain the sum of the two refractions, so that in this case the rule becomes as follows: "Take the depression from the sum of the contained arc and elevation, and half the remainder is the refraction."

The quantity of this terrestrial refraction is estimated by Dr. Maskelyne at one-tenth of the distance of the object observed, expressed in degrees of a great circle. Whence, if the distance be 10,000 fathoms, its 10th part, 1000 fathoms, is the 60th part of a degree, or one minute, which, therefore, is the refraction in altitude of the object at that distance. But Le Gendre is induced, by several experiments, to allow only one-fourteenth part of the distance for the refraction in the altitude, so that on the distance of 10,000 fathoms, the 14th part of which is 714 fathoms, he allows only $44''$ of terrestrial refraction, so many being contained in 714 fathoms. (See his Memoir on the Trigonometrical Operations.) Again, Delambre makes the quantity of terrestrial refraction to be one-eleventh part of the arc of distance. And the English measurers, from many very exact observations, determine the quantity of the medium refraction to be a twelfth part of the said distance. The mean of all these is about .085 of the intercepted arc, which is probably not very far from the truth: this quantity, however, it must be observed, is found to vary very considerably with the different states of the weather and atmosphere, from one-seventh to one-eighteenth of the contained arc.

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TABLE I. Of Refraction.

Barometer 29.922 Inches = 0.76 Metre; Thermometer Centigrade, 14°; Fahrenheit's, 57°.2; Reaumur's, 11°.2.

Apparent altitude.	Refraction minus parallax of the ☉	Refraction of the stars.	Differences.	Apparent altitude.	Refraction minus parallax of the ☉	Refraction of the stars.	Differ.	Apparent altitude.	Refraction minus parallax of the ☉	Refraction of the stars.	Diff.	Apparent altitude.	Refraction minus parallax of the ☉	Refraction of the stars.	Differ.
0 0	33 7	33 16	110	0 0	8 13	8 22	11	21	2 20	2 28	7	56	0 34	0 39	1
10	31 17	31 25	103	10	8 2	8 11	11	22	2 13	2 21	7	57	0 33	0 37	1
20	29 33	29 42	96	20	7 51	7 59	11	23	2 6	2 14	6	58	0 31	0 36	1
30	27 57	28 6	88	30	7 40	7 48	11	24	2 0	2 8	5	59	0 30	0 35	1
40	26 29	26 38	82	40	7 29	7 38	10	25	1 55	2 3	5	60	0 29	0 33	1
50	25 7	25 15	76	50	7 19	7 28	10	26	1 49	1 57	5	61	0 28	0 32	1
1 0	23 50	23 59	70	7 0	7 9	7 18	9	27	1 44	1 52	4	62	0 26	0 31	1
10	22 40	22 49	65	10	7 0	7 9	9	28	1 40	1 48	4	63	0 25	0 29	1
20	21 35	21 44	61	20	6 51	7 0	9	29	1 36	1 43	4	64	0 24	0 28	1
30	20 34	20 43	56	30	6 43	6 51	8	30	1 32	1 39	4	65	0 23	0 27	1
40	19 38	19 47	53	40	6 35	6 44	8	31	1 28	1 35	4	66	0 22	0 26	1
50	18 45	18 54	48	50	6 27	6 36	7	32	1 24	1 32	3	67	0 21	0 24	1
2 0	17 57	18 6	45	8 0	6 20	6 28	7	33	1 21	1 28	3	68	0 20	0 23	1
10	17 12	17 20	43	10	6 13	6 21	7	34	1 18	1 25	3	69	0 19	0 22	1
20	16 29	16 38	39	20	6 5	6 14	7	35	1 15	1 22	3	70	0 18	0 21	1
30	15 50	15 59	37	30	5 58	6 7	6	36	1 12	1 19	3	71	0 17	0 20	1
40	15 13	15 22	35	40	5 52	6 1	6	37	1 9	1 16	3	72	0 16	0 19	1
50	14 39	14 47	32	50	5 46	5 54	6	38	1 6	1 13	3	73	0 15	0 18	1
3 0	14 6	14 15	30	9 0	5 39	5 48	6	39	1 4	1 11	2	74	0 14	0 17	1
10	13 36	13 45	29	10	5 33	5 42	6	40	1 2	1 8	2	75	0 13	0 15	1
20	13 7	13 16	27	20	5 28	5 36	6	41	0 59	1 6	2	76	0 12	0 14	1
30	12 41	12 49	25	30	5 22	5 31	5	42	0 57	1 4	2	77	0 11	0 13	1
40	12 15	12 24	24	40	5 17	5 25	5	43	0 55	1 2	2	78	0 10	0 12	1
50	11 51	12 0	22	50	5 12	5 20	5	44	0 53	0 59	2	79	0 10	0 11	1
4 0	11 29	11 38	22	10 0	5 6	5 15	28	45	0 51	0 57	2	80	0 9	0 10	1
10	11 7	11 16	20	11 0	4 39	4 47	23	46	0 49	0 55	2	81	0 8	0 9	1
20	10 47	10 56	19	12 0	4 15	4 24	20	47	0 48	0 54	2	82	0 7	0 8	1
30	10 28	10 37	18	13 0	3 55	4 4	18	48	0 46	0 52	2	83	0 6	0 7	1
40	10 10	10 19	17	14 0	3 38	3 46	15	49	0 44	0 50	1	84	0 5	0 6	1
50	9 53	10 2	16	15 0	3 23	3 31	14	50	0 43	0 48	1	85	0 4	0 5	1
5 0	9 37	9 45	15	16 0	3 9	3 18	12	51	0 41	0 46	1	86	0 3	0 4	1
10	9 21	9 30	15	17 0	2 57	3 6	11	52	0 39	0 45	1	87	0 3	0 3	1
20	9 6	9 15	14	18 0	2 47	2 55	10	53	0 38	0 43	1	88	0 2	0 2	1
30	8 52	9 1	14	19 0	2 37	2 45	9	54	0 37	0 42	1	89	0 1	0 1	1
40	8 38	8 47	13	20 0	2 28	2 36	8	55	0 35	0 40	1	90	0 0	0 0	1
50	8 26	8 34	12	21 0	2 20	2 28		56	0 34	0 39	1				
6 0	8 13	8 22													

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TABLE II. Of Corrections to the preceding Table of Refractions for different Degrees of Temperature. An Increase of Cold augments Refraction; therefore, the Correction is Additive for a Temperature less than 14° of the Centigrade, and Subtractive for those above it.

Centigrade Fahrenheit Reaumur	Correction Additive.								Correction Subtractive.									
	-2°	0°	+2°	+4°	+6°	+8°	+10°	+12°	+14°	+16°	+18°	+20°	+22°	+24°	+26°	+28°	+30°	
	28.4	32	35.6	39.2	42.8	46.4	50	53.6	57.2	60.8	64.4	68	71.6	75.2	78.8	82.4	86	
	-1.6	0°	+1.6	+3.2	+4.8	+6.4	+8	+9.6	+11.2	+12.8	+14.4	+16	+17.6	+19.2	+20.8	+22.4	+24	
Apparent Altitude.																		
0	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	
5	37	32	28	23	18	14	9	5	0	4	9	13	17	21	25	29	33	
5½	35	30	26	21	17	13	8	4	0	4	8	12	16	20	23	27	31	
6	32	28	24	20	16	12	8	4	0	4	7	11	14	18	22	25	28	
7	28	24	21	17	14	10	7	3	0	3	6	10	13	16	19	22	25	
8	25	22	18	15	12	9	6	3	0	3	6	9	11	14	17	21	22	
9	22	19	16	14	11	8	5	3	0	3	5	8	10	13	15	17	20	
10	20	17	15	12	10	7	5	3	0	2	5	7	9	11	14	16	18	
12	17	15	12	10	8	6	4	2	0	2	4	6	8	10	11	13	15	
14	14	13	11	9	7	5	4	2	0	2	3	5	7	8	10	11	13	
16	13	11	9	8	6	5	3	2	0	1	3	4	6	7	9	10	11	
18	11	10	8	7	5	4	3	1	0	1	3	4	5	6	8	9	10	
20	10	9	7	6	5	4	2	1	0	1	2	3	5	6	7	8	9	
25	8	7	6	5	4	3	2	1	0	1	2	3	4	5	5	6	7	
30	6	6	5	4	3	2	2	1	0	1	2	2	3	4	4	5	6	
40	4	4	3	3	2	2	1	1	0	1	1	2	2	3	3	3	4	
50	3	3	2	2	2	1	1	0	0	0	1	1	1	2	2	2	3	
60	2	2	2	1	1	1	1	0	0	0	1	1	1	1	1	2	2	
70	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	
80	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

TABLE III. Of Corrections to the Table of Refractions relative to the Weight of the Atmosphere. An Increase of Atmospheric Pressure augments Refraction; the Correction is Additive when the Barometer is more than 29.922 Inches, but Subtractive when less.

Metres. Inches.	Correction Additive.								Correction Subtractive.							
	0.795	0.790	0.785	0.780	0.775	0.770	0.765	0.760	0.755	0.750	0.745	0.740	0.735	0.730	0.725	
	31.301	31.104	30.907	30.710	30.513	30.316	30.119	29.922	29.725	29.528	29.331	29.134	28.937	28.740	28.543	
Apparent Altitudes.																
0	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	
5	27	23	19	16	12	8	4	0	4	8	12	16	20	24	27	
5½	25	22	18	14	11	7	4	0	4	7	11	15	18	22	25	
6	24	20	17	13	10	7	3	0	3	7	10	14	17	20	24	
7	21	18	15	12	9	6	3	0	3	6	9	12	15	18	21	
8	18	16	13	10	8	5	3	0	3	5	8	11	14	16	18	
9	16	14	12	9	7	5	2	0	2	5	7	10	12	14	16	
10	15	12	11	8	6	4	2	0	2	4	6	9	11	13	15	
12	12	11	9	7	5	4	2	0	2	4	5	7	9	11	12	
14	10	9	8	6	5	3	2	0	2	3	5	6	8	9	11	
16	9	8	7	5	4	2	1	0	1	3	4	5	7	8	9	
18	8	7	6	5	4	2	1	0	1	2	4	5	6	7	8	
20	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	
25	6	5	4	3	3	2	1	0	1	2	3	4	5	5	6	
30	5	4	3	3	2	1	1	0	1	1	2	3	3	4	5	
40	3	3	2	2	1	1	1	0	0	1	1	2	2	3	3	
50	2	2	2	1	1	1	0	0	0	1	1	1	2	2	2	
60	2	1	1	1	1	1	0	0	0	0	1	1	1	1	2	
70	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	
80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

To observe the Refraction of a Star, &c. 1. Observe the meridian altitude of a star near the zenith; whence the latitudes of the place being known, the true declination of the star is easily had, the star being now void of any sensible refraction. 2. Observe the altitude of the same star in any other degree, and note the time by a pendulum. 3. For the given time of observation, from the declination of the star compute its true altitude.

This being thus found less than the altitude observed, subtract the one from the other; and the remainder is the refraction for that moment, in that degree.

REFRACTION of Altitude, is an arc of a vertical circle, by which the altitude of a star is increased by the refraction.

REFRACTION of Declination, is an arc of a circle of declination, by which the declination of a star is increased or diminished by the refraction.

REFRACTION of Ascension and Descension, is an arc of the equator, by which the ascension and descension of a star, whether right or oblique, is increased or diminished by means of the refraction.

REFRACTION of Longitude, is an arc of the ecliptic, by which the longitude of a star is increased or diminished by means of the refraction.

REFRACTION of Latitude, is an arc of a circle of latitude, by which the latitude of a star is increased or diminished by means of refraction.

REFRACTION, in *Commerce*, is a term sometimes used by merchants, where there has been an oversight in an account, to the prejudice of a person; who thereupon demands restitution of so much, added or omitted by mistake.

You must make me a refraction of five pounds forgot in your account. I will deduct or make you a refraction of 30s. charged inadvertently in my bill.

REFRACTORY, in *Chemistry*. See an explication of the term under **APYROUS**.

REFRAIN, Fr., in *Musick*, the termination of every verse or stanza of a song, by the same words and the same melody. (See **BURDEN**.) The word, according to Menage (Dict. Etym.) is derived from the Spanish *refran*.

REFRAN, Span., a proverb; the burden of a song in that language, being usually sententious, and including some moral precept.

REFRANGIBLE, whatever is capable of being refracted. See **REFRANGIBILITY**.

REFRANGIBILITY of Light, the disposition of the rays to be refracted.

A greater or less refrangibility is a disposition to be more or less refracted, in passing at equal angles of incidence, into the same medium.

That the rays of light are differently refrangible, is the foundation of sir Isaac Newton's whole theory of light and colours. The truth of the principle, which was investigated and established by our great philosopher in the year 1616, will appear from the following experiments.

1. Let *EG* (*Plate XIX. Optics, fig. 1.*) represent the window-shutter of a dark room, and *F* a hole in it, through which the light is transmitted to the prism *ABC*, which refracts it towards *P T*, where it appears in an oblong form; its length being about five times greater than its breadth, and exhibiting the various colours of the rainbow. In *fig. 2.* *agb* represents a second prism, which refracts the light back again to *Q*, where the image is round; whereas, without the interposition of this second prism, the light would have proceeded to *P T*, and, consequently, have been oblong, as before. In this experiment sir Isaac Newton took care that the plane *ag* was placed exactly parallel to *BC*, and also *bg* to *AC*, that the rays might be equally refracted,

though in contrary ways, by both prisms. He also observed, that both prisms must be placed very near to one another; for if their distance be so great, that colours begin to appear in the light, before its incidence on the second prism, those colours will not be destroyed by the refraction of that prism.

2. Having placed one of two boards behind the prism at the window, so that the light might pass through a small hole made in it for the purpose, and fall on the other board at the distance of about twelve feet, a hole being made in it to admit the passage of the incident light, he then placed another prism behind the second board, so that the light which was transmitted through both the boards, might pass through that also, and be again refracted before it arrived at the wall. This being done, he took the first prism in his hand, and turned it about its axis so much, as to make the several parts of the image, cast on the second board, successively to pass through the hole in it, that he might observe to what places on the wall the second prism would refract them; and he saw, by the change of those places, that the light tending to that end of the image, towards which the refraction of the first prism was made, did, in the second prism, suffer a refraction considerably greater than the light which tended to the other end. The true cause, therefore, of the length of that image was discovered to be no other, than that light is not similar or homogeneous, but that it consists of rays, some of which are more refrangible than others; so that without any difference in their incidence on the same medium, some of them shall be more refracted than others; and therefore, that according to their particular degrees of refrangibility, they will be transmitted through the prism to different parts of the opposite wall.

To make this capital experiment, which sir Isaac Newton himself justly calls the *experimentum crucis*, let *S F* (*fig. 3.*) represent a ray of the sun, which, after passing through a hole in the window-shutter *F*, is received by the prism in *A B C*, close behind which is placed a board *D E*, with a hole in it at *G*, to admit any of the rays after they have been separated by the prism; then *de* will represent the other board, placed at a considerable distance from the former, with a hole in it, *g*, to receive any part of the light transmitted through the other board. Behind this second board is placed another prism, *a b c*, through which different rays of light, falling upon it in the very same place, and with precisely the same angle of incidence, will be refracted higher or lower, on the opposite wall *M N*. This experiment was conducted with the utmost circumspection and accuracy; and it is observed, that neither the different magnitude of the hole in the window-shutter, nor the different thicknesses of the prism, at the place where the rays passed through it, nor the different inclinations of the prism to the horizon, nor the different matter of the prisms, made any sensible change in the length of the image.

3. In order farther to establish this famous hypothesis of the different refrangibility of the rays of light, he held a prism in a beam of the sun, which was transmitted into the room through a hole in the window-shutter, so that its axis might be perpendicular to that beam; and having turned the prism about its axis to make the image ascend and descend, and when it seemed to be stationary between these contrary motions, he fixed the prism so that the refractions of both sides might be equal to each other. In this situation he looked at the hole through the prism, and observed the length of its refracted image to be many times greater than its breadth: the most refracted part of it was violet, the least refracted red, the middle parts blue, green, and yellow, in order. The same thing happened when he removed the prism

REFRANGIBILITY.

out of the sun's light, and looked through it upon the hole shining by the light of the clouds beyond it.

4. Considering that if the image of the sun should be drawn into an oblong form, either by a dilatation of every ray, or by any other casual inequality of the refractions, the same oblong image would, by a second refraction, made sideways, be drawn out as much in breadth, he placed a second prism immediately after the first, in an oblique position with respect to it, that it might again refract the light of the beam of the sun's light, which came to it through the first prism; so that in the first prism, the beam would be refracted upwards, and in the second sideways. But he found that the breadth of the image was not increased by the refraction of the second prism, but only its upper part, which in the first prism suffered the greatest refraction, and appeared violet and blue, did again, in the second prism, suffer a greater refraction, than the lower part of it, which was red and yellow, and this without any dilatation of the breadth of the image. Thus let S (*fig. 4.*) represent the sun, F the hole in the window, A B C the first prism, and D H the second. If Y represent the round image of the sun, made by a direct beam of light, when the prisms are taken away, P T will be the oblong image of the sun, made by the same beam passing through the first prism only, and *p t* will be the image made by the cross refractions of both prisms together. Sometimes he placed a third prism after the second, and sometimes a fourth after the third; by all which the image might be often refracted sideways, but the rays which were more refracted than the rest in the first prism, were also more refracted in all the others, and that without any dilatation of the image sideways; and, therefore, those rays, on account of their constancy of a greater refraction, he called the more refrangible ones. He observes, in order to render the meaning of this experiment more evident, that all the rays, which are equally refrangible, fall upon a circle answering to the sun's disc. Let, therefore, A G (*fig. 5.*) represent the circle which all the most refrangible rays, transmitted from the whole disc of the sun, would illuminate, and paint upon the opposite wall, if they were alone. Let E L be the circle which all the least refrangible rays would, in like manner, illuminate, and paint, if they were alone, and let B H, C J, and D K, be the circles which so many intermediate kinds of rays would successively paint upon the wall, if they were singly propagated from the sun, the rest being always intercepted, and conceive that there are other intermediate circles without number, which other innumerable intermediate kinds of rays would successively paint upon the wall, if the sun should successively emit every kind by itself. Now since the sun emits rays of all these kinds at once, they must altogether illuminate and paint innumerable equal circles, of all which, being ranged according to their different degrees of refrangibility, the oblong image P T before described is composed.

Now if the sun's circular image, Y, which is made by an unrefracted beam of light, was by any dilatation of the single rays, or by any other irregularity in the refraction of the first prism, converted into the oblong image P T, then ought every circle in the image to be in like manner drawn out into a similar oblong figure, contrary to the result of this experiment.

He considered farther, that by the breadth of the hole through which the light enters into the dark chamber, there is a penumbra made in the circumference of the image Y, which is also visible at the sides of the oblong images P T and *p t*. He, therefore, placed at that hole a lens, or object-glass of a telescope, which might cast the image of the sun distinctly on Y, without any penumbra at all; and he

found that the penumbra of the rectilinear sides of the oblong images P T and *p t* was also thereby taken away, so that they were as distinctly defined as the circumference of the first image Y.

There are some other circumstances attending this experiment, by which the conclusion drawn from it is made still more plain and convincing.

Let the second prism, D H, (*fig. 6.*) be placed not immediately after the first, but at some distance from it, so that the light from the first prism may fall upon it in the form of an oblong spectrum *q r*, parallel to this second prism, and may be refracted sideways, to form the oblong image, *p t*, upon the wall, and it will be found that this image, *p t*, is inclined to the image P T, which the first prism would have formed without the second; the blue ends, P and *p*, being farther distant from one another than the red ones, T and *t*; and, consequently, the rays which go to the blue end, *q*, of the image *q r*, and which, therefore, suffer the greatest refraction in the first prism, are again, in the second prism, more refracted than the rest.

At two holes made near one another in his window-shutter, he placed two prisms, one at each, which might cast upon the opposite wall two oblong coloured images of the sun; and at a little distance from the wall he placed a long slender paper, with straight and parallel edges; and he placed the prisms and papers, so that the red colour of one image, at T, (*fig. 7.*) might fall directly upon one half of the paper, and the violet colour, M, of the other image, upon the other half of the same paper. Then with a black cloth he covered the wall behind the paper, that no light might be reflected from it to disturb the experiment; and viewing the paper through a third prism, held parallel to it, he saw that half of it which was illuminated by the violet light to be divided from the other half, by a greater refraction, especially when he retired to a considerable distance from the paper.

He farther caused the two images, P T and M N (*fig. 8.*) to coincide, in an inverted order of their colours, the red end of each falling on the violet end of the other; and then viewing them through a prism D H, held parallel to their length, they no longer appeared coincident, as when they were viewed with the naked eye, but in the form of two distinct images, *p t* and *m n*, crossing one another in the middle; which shews that the red of the one image, and the violet of the other, which were coincident at P N and M T, being parted from one another by a greater refraction of the violet to *p m*, than that of the red to *n* and *t*, differ in degree of refrangibility.

Having placed a prism, whose two angles at its base were equal to one another, and half right ones, and the third a right one, in a beam of the sun's light, admitted into the room as before, he turned it slowly about its axis, till all the light which went through one of its angles, and was refracted by it, began to be reflected by its base, (at which, till then, it went out of the glass,) and then he observed that those rays which had suffered the greatest refraction were sooner reflected than the rest. He imagined, therefore, that those rays of the reflected light, which were most refrangible, did first of all, by a total reflection, become more copious in that light than the rest; and that afterwards the rest, also, by a total reflection, became as copious as these. To try this, he made the reflected light pass through another prism, and, being refracted by it, to fall afterwards upon a sheet of white paper, at some distance behind it, and there to paint the usual colours of the prism. Then causing the first prism to be turned about its axis, he observed, that when those rays which, in this prism, had suffered the greatest

greatest refraction, and were of a blue and violet colour, began to be wholly reflected, the blue and violet light on the paper, which received the rays from the second prism, was sensibly increased, above that of the red and yellow, which was least refracted; and afterwards, when the rest of the light, which was green, yellow, and red, began to be wholly reflected in the first prism, the light of those colours on the paper received as great an increase as the violet and blue had done before. From this it is manifest, that the beam reflected by the base of the prism, being augmented first by the more refrangible rays, and afterwards by the less refrangible ones, is compounded of rays differently refrangible. This experiment is illustrated by *fig. 9*, in which *ABC* represents the first prism, on the base of which the light falls, at *M*. When this prism is turned about its axis, according to the order of the letters *ABC*, the more refrangible rays, *MH*, emerge more and more obliquely; and at length, after their most oblique emergence, are reflected towards *N*, and going on to *p*, increase the number of rays *Np*. By continuing the motion of the first prism, the less refrangible rays, *MG*, are reflected to *N*, and increase the number of rays *Nt*.

Since it appears from sir Isaac Newton's experiments, that different rays of light have different degrees of refrangibility, it necessarily follows that the rules laid down by preceding philosophers, concerning the refractive power of water, glass, &c. must be limited to the middle kind of rays, as it may be supposed that Kepler, Snellius, and others would attend to them principally. Sir Isaac, however, proves that the sine of the incidence of every kind of light, considered apart, is to its sine of refraction in a given ratio. This he deduces both by experiment, and also geometrically, from the supposition that bodies refract the light by acting upon its rays in lines perpendicular to their surfaces.

Upon the whole it appears, that the blue rays are more refracted than the red ones, and that there is, likewise, unequal refraction in the intermediate rays; and upon the whole it appears, that the sun's rays have not all the same refrangibility, and, consequently, are not of the same nature. It is also observed, that those rays which are most refrangible are also most reflexible. See the proof of this under REFLEXIBILITY. Newton's Optics, p. 22, &c. ed. 3.

The difference between refrangibility and reflexivity was first discovered by sir Isaac Newton, in 1671-2, and communicated in a letter to the Royal Society, dated February 6, 1671-2, and published in the Philosophical Transactions, N^o 80, p. 3075, and from that time vindicated by him from the objections of several authors; particularly F. Pardies, M. Mariotte, Fr. Linus, or Lin, and other gentlemen at the English college at Liege; and at length it was more fully laid down, illustrated, and confirmed, by a great variety of experiments, in his excellent treatise of Optics.

But farther, as not only those colours of light produced by refraction in a prism, but also those reflected from opaque bodies, have their different degrees of refrangibility and reflexivity; and as a white light arises from a mixture of the several coloured rays, the same great author concluded all homogeneous light to have its proper colour, corresponding to its degree of refrangibility, and not capable of being changed by any reflections, or any refractions; that the sun's light is composed of all the primary colours; and that all compound colours arise from a mixture of the primary ones, &c.

The different degrees of refrangibility he conjectures to

arise from the different magnitude of the particles of which the different rays consist. Thus the most refrangible rays, *i. e.* the red ones, he supposes to consist of the largest particles; the least refrangible, *i. e.* the violet rays, of the smallest particles; and the intermediate rays, yellow, green, and blue, of particles of intermediate sizes.

Having given a general view of the Newtonian theory of colours, as they depend upon the refraction of light, under the article COLOUR, we shall here add some farther particulars on this subject. From a review of that article, and of what has been above delivered, we may infer that, as the rays of light differ in refrangibility, they also differ in their disposition to exhibit this or that particular colour; so that colours are not modifications of light, derived from refractions or reflections of natural bodies, but original and connate properties, which are different in different rays. Moreover, to the same degree of refrangibility always belongs the same colour, and to the same colour the same degree of refrangibility; nor are the same species of colour, and degree of refrangibility, that are proper to any particular kind of rays, susceptible of change by refraction and by reflection of natural bodies, nor by any other cause which sir Isaac Newton could observe. Although a seeming transmutation of colours may be made by a mixture of different kinds of rays, yet, in such mixtures, the component colours themselves do not appear; but, by their mutually allaying each other, constitute a middle colour: and, therefore, if, by refraction, the different rays be separated, colours will emerge different from that of the composition. Thus blue and yellow powders, finely mixed, appear green to the naked eye; and yet the colours of the component particles are not thereby really changed, but only blended: for when they are viewed with a microscope, they still appear blue and yellow. It appears that there are also two sorts of colours: the one original and simple; the other compounded of these. The original and primary colours are red, orange, yellow, green, blue, indigo, and a violet purple, and an indefinite variety of intermediate gradations. The same colours in specie with those primary ones may be also produced by a composition: thus a mixture of yellow and blue makes green; of red and yellow, orange; and of orange and yellowish-green, yellow. In general, if any two colours are mixed, which, in the series of those that are produced by the prism, are not too far distant from one another, they, by their mutual alloy, compose that colour which appears in the midway between them; but those which are situated at too great distance have not this effect: *e. gr.* orange and indigo do not produce the intermediate green, nor scarlet and green the intermediate yellow.

The most wonderful composition is that of whiteness, which no one sort of rays alone can exhibit, but which is always compounded; so that all the aforesaid primary colours, mixed in a certain proportion, are necessary to form it. See COLOUR.

Having shewn, in the preceding part of this article, the extremes of the different degrees of refrangibility in the different kinds of light, we shall now proceed to give the result of Newton's investigation, concerning the different degrees of refrangibility of all the different kinds of light, according to their several colours; particularizing this part of the subject with an explanation of the method which he made use of to define the boundaries of each colour, in the oblong image of the sun above described. In that image, though there was a manifest difference of colour, not only between the two extremes, but also in the intermediate parts, yet the exact place at which any one colour ended, and another began, was far from being sufficiently distinguishable.

guishable. The reason of this indistinctness is, that rays of every kind coming from all parts of the sun's disc, an entire image of the sun is projected on the paper, consisting of a circle of each particular colour; and as the rays differ in kind by infinitesimal degrees, from the extreme red to the extreme violet, there must, in fact, be thousands of these circles in the same oblong image, the centres of which are infinitely near to one another; so that the light is intimately mixed, especially in the middle of the image, where it is the brightest.

If these circles, as he observes, whilst their centres keep their distances and positions, could be made less in diameter, their interfering one with another, and consequently the mixture of heterogeneous rays, would be proportionably diminished. Thus, in P T, (*fig. 10.*) the circles of which the solar image consists, expand into one another; but in the same figure, *pt*, being composed of less circles, but having their centres at the same distance as the former, do not extend into one another, the mixture being diminished in proportion to the diameters of the circles.

Now these circles would be diminished, if, without the room, at a great distance from the prism, towards the sun, some opaque body was placed, having a round hole in the middle of it, to intercept all the sun's light, excepting so much as, coming from the middle of its disc, could pass through that hole to the prism; for so the separate circles would no longer answer to the whole disc of the sun, but only to that part of it which can be seen from the prism, through that hole. But that these circles may answer more distinctly to the hole, a lens is to be placed by the prism, to cast the image of the hole, that is, of each separate circle, distinctly upon the paper; and if this be done, it will not be necessary to place that hole very far off, not even beyond the window. Instead, therefore, of that hole, he made use of the hole in his window-shutter, in the following manner.

At about 10 or 12 feet from the window, he placed a lens, by which the image of the hole might be distinctly cast upon a sheet of white paper, at the distance of 6, 8, 10, or 12 feet from the lens. Then, immediately after the lens, he placed a prism, by which the refracted light might be thrown upwards, or sideways; and he moved the paper that received it, either towards the prism, or from it, till he found the exact distance at which the sides of the image appeared most distinct. By this means the circular images of the hole were terminated most distinctly, without any penumbra, and therefore extended into one another the least that they could; and consequently the mixture of the heterogeneous rays was the least of all. And by using a greater or less hole in the window-shutter, he made the circular images greater or less at pleasure, and thereby the mixture of rays in the oblong image was as much or as little as he chose. He sometimes made the breadth of the image 40 times, and sometimes 60 or 70 times less than its length. In this manner, he says, light is made sufficiently simple, and homogeneous, for trying any of his experiments about simple light; for that the heterogeneous rays in this light are so few, as hardly to be perceived, excepting, perhaps, in the indigo and violet, which, being dark colours, do easily suffer a sensible alloy by that little scattering light, which used to be refracted irregularly by the inequalities of the prism. The whole process of this experiment is so evident, by inspection of *fig. 11*, that it needs no particular illustration.

Instead of a circular hole, our author recommends a hole shaped like a long parallelogram, with its length parallel to the prism. For if this hole be an inch or two long, and

but a 10th or 20th part of an inch broad, or narrower, the light of the image will be as simple as before, or more simple, and the image will become much broader, and therefore more fit for these experiments.

Or, instead of this hole, another may be formed of a triangle of equal sides, whose base may be about the 10th part of an inch, and its height an inch or more. For, by this means, if the axis of the prism be parallel to the perpendicular of the triangle, the image *pt* (*fig. 12.*) will now be formed of equicrural triangles, *ag, bh, ci, dk, el, fm*, &c. and innumerable other intermediate ones, answering to the triangular hole in shape and bigness, and lying one after another in a continual series, between two parallel lines, *af, gm*. These triangles are a little intermingled at their bases, but not at their vertices; and therefore the light on the brighter side, *af*, of the image, where the bases of the triangles are, is a little compounded, but on the darker side, *gm*, it is altogether uncompounded; and in all places between the sides, the composition is proportionable to the distances of the places from that obscure side *gm*; and having an image of such a composition, we may try experiments either in its stronger and less simple light, near the side *af*; or in its weaker and more simple light, near the other side *gm*, as shall seem most convenient.

In making these experiments, he advises, that the chamber be made very dark, that the lens be very good, being made of glass free from bubbles and veins, the sides of the prism truly plane, and its polish elaborate, with an angle of about 65 or 70 degrees; and the edges of the prism and lens, as far as they make any irregular refraction, should be covered with black paper glued on them. He also observes, that all the useless light should be intercepted with black paper, or other black obstacles. It being difficult to get glass prisms fit for these nice experiments, he sometimes used prismatic vessels made with pieces of broken looking-glasses, and filled with rain-water; and to increase the refraction, he sometimes strongly impregnated the water with *saccharum saturni*.

When he had, by this means, got the sides of the coloured image, as A F, G M, (*fig. 13.*) distinctly defined, he delineated on paper the outlines of it F A P G M T, and held the paper so that the image might fall on this figure, and coincide with it exactly; whilst an assistant, whose eyes could distinguish colours better than his own, did, by right lines drawn across the image, mark the confines of each colour; and this operation being frequently repeated, both on the same and on different papers, he found that the observations agreed well enough with one another, and that the sides, M G and F A, were by this means divided like a musical chord; so that if G M were produced to X, making M X equal to G M, and if G X, I X, i X, b X, e X, g X, a X, M X, were in proportion to one another, as the numbers 1, $\frac{2}{3}$, $\frac{4}{5}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{12}$, and $\frac{1}{2}$, and so represented the chords of the key, and of a tone, a third minor, a fourth, a fifth, a sixth major, a seventh, and an eighth above that key. And the intervals M a, a g, g e, e b, b i, i l, and l G, were the spaces which the several colours, red, orange, yellow, green, blue, indigo, and violet, took up.

Now these intervals or spaces, subtending the differences of the refractions of the rays, going to the limit of those colours, that is to the points M, a, g, e, b, i, l, G, may, without any sensible error, be accounted proportional to the differences of the sines of refraction of those rays, having one common sine of incidence; and, therefore, since the common sine of incidence of the most and least refrangible rays, out of glass into air, was found in proportion to their sines of refraction as 50 to 77 and 78; if the difference between

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tween 77 and 78 be divided, as the line *GM* is divided by those intervals, there will be 77, $77\frac{1}{2}$, $77\frac{1}{3}$, $77\frac{1}{4}$, $77\frac{1}{5}$, $77\frac{1}{6}$, $77\frac{1}{7}$, 78, for the lines of refraction of those rays out of glass into air, their common line of incidence being 50. So then the lines of the incidences of all the red-making rays out of glass into air were to the lines of their refractions not greater than 50 to 77, nor less than 50 to $77\frac{1}{6}$; but they varied from one another according to all their intermediate proportions, and so of the other colours.

Having demonstrated that the light of the sun consists of a certain proportion of differently coloured light, our author proves, by another series of experiments, what has been already demonstrated by a single one mentioned above, that when a beam of light has been divided into its component parts, if they be again mixed, they will produce white: or if any one of them be intercepted, the image will appear tinged, and in a different manner, according to the different colours that are thereby prevented from mixing with the rest: and to complete the whole, he observes, that intercepting all the colours that compose the white image except one, and thereby making it to exhibit the appearance of all the colours in order; yet, if he made this succession of all the colours very quick, the appearance was always white, though it was demonstrable that only one colour took place at any one time; and he justly observes, that if each of these colours in succession give the idea of whiteness, much more will they produce that effect, when they are so intimately mixed as they are in a natural sun-beam.

Not content with composing whiteness from the separately coloured rays of the sun, he attempted, and succeeded in his attempt, to do the same with natural coloured bodies, observing the same proportions of the respective colours that he had found in the solar image. The coloured powders which he made use of at first produced only a kind of grey; but this was in fact a dull white, or whiteness mixed with shade: for when he contrived to throw a very strong light upon it, it became intensely white, so that a friend of his, who happened to call upon him while he was busy about these curious experiments, and who knew nothing of what he had been doing, pronounced that the powders he had been mixing, when thus illuminated, made a better white than some very fine white paper, with which he was comparing it.

As the preceding proportion of all the prismatic colours makes a white, it is evident that when they are mixed in different proportions, or when only a few of them are used, they will make different colours; and our philosopher has given us the following ingenious method of knowing, in a mixture of primary colours, the quantity and quality of each being given, the colour of the compound. With the centre *O*, (*fig. 14.*) and the radius *OD*, describe a circle *ADF*, and divide the circumference into seven parts, proportional to the seven musical tones or intervals contained in an octave, that is in proportion to the numbers $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$. Let the first, *DE*, represent a red colour, the second, *EF*, orange, and so of the rest; and let all these colours be supposed to pass gradually into one another. Let *p* be the centre of gravity of the arc *DE*, and *q, r, s, t, u, x*, be the centres of gravity of the other arcs; and about those centres let circles, proportional to the number of rays of each colour in the given mixture, be described. Then find a common centre of gravity of all those circles; and if a line be drawn from the centre of the circle *O*, through this point, as suppose at *z*, the point *Y*, in which it terminates at the circumference, will shew the colour that arises from the mixture; and the line *OZ* will be proportioned to the fullness or intenseness of the colour, the centre

O representing perfect white. But if only two of the primary colours, which in this circle are opposite to one another, be mixed in an equal proportion, the point *Z* will fall upon the centre *O*, and yet the colour compounded of those two will not be perfectly white, but some faint anonymous colour; for he could never, by mixing only two primary colours, produce a perfect white. Whether it might be the result of three taken at equal distances in the circumference he could not tell; but he did not much question, but that four or five of them would be sufficient. These, however, as he observes, are curiosities of little or no moment to the understanding of the phenomena of nature, since, in all natural whites, there is a mixture of all kinds of rays. *Newton's Optics. Priestley's Hist. of Light and Colours.*

For the method of correcting the effect of the different refrangibility of the rays of light in glasses, see *ABERRATION and TELESCOPE*; see also *DISPERSION of Light*.

REFRANGIBILITY of Radiant Heat. See *RAYs of Heat*. Radiant heat, as well as light, is not only refrangible, but it is also subject to the laws of the dispersion, arising from its different refrangibility. The prism refracts radiant heat, so as to separate that which is less efficacious from that which is more so. The whole quantity of radiant heat contained in a sun beam, if this different refrangibility did not exist, must inevitably fall uniformly on a space equal to the area of the prism; and if radiant heat were not refrangible at all, it would fall upon an equal space, in the place where the shadow of the prism, when covered, may be seen. But neither of these events taking place, it is evident that the radiant heat is subject to the laws of refraction, and also to those of the different refrangibility of light. Whence Dr. Herschel is led to surmise, that radiant heat consists of particles of light of a certain range of momenta, which range may extend a little farther, on each side of refrangibility, than that of light. (See *RAYs of Heat*.) Dr. Herschel having found that two degrees of heat were obtained from that part of the prismatic spectrum which contained the violet rays, while the full red colour, on the opposite side, gave no less than seven degrees, infers from these facts the different refrangibility of the rays which occasion heat, as clearly and certainly as it is concluded that the refrangibility of light is ascertained by the dispersion and variety of the colours. But he proceeds farther, and observes, that the rays of heat are of a much more extensive refrangibility than those of light. In order to make this appear, he delineates a spectrum of light, by assuming a line of a certain length; and, dividing it into seven parts, according to the dimensions assigned to the seven colours by sir Isaac Newton, in the fourth figure of the second part of his *Optics*, represents the illuminating power of which each colour is possessed, by an ordinate drawn to that line. And here, as the absolute length of the ordinates is arbitrary, provided they be proportional to each other, he assumes the length of that which is to express the maximum, equal to $\frac{2}{3}$ of the whole line.

Thus, let *GQ* (*fig. 15.*) represent the line that contains the arrangement of the colours, from the red to the violet. Then, erecting on the confines of the yellow and green the line *LR* = $\frac{2}{3}$ of *GQ*, it will represent the power of illumination of the rays in that place. For, by experiments already delivered, we have shewn that the maximum of illumination is in the brightest yellow or palest green rays. From the same experiments we collect, that the illuminations of yellow and green are equal to each other, and not much inferior to the maximum; this gives us the ordinates *K* and *M*. Then, by the rest of the same experiments, we obtain also the

the ordinates H, I, N, O, P, with sufficient accuracy for the purpose here intended. All these being applied to the middle of the spaces which belong to their respective colours, we have the figure G R Q G, representing what may be called the spectrum of illumination.

We are now, in the same manner, to find a figure to express the heating power of the refracted prismatic rays, or what may be called the spectrum of heat. In order to determine the length of the base, Dr. Herschel examined the extent of the invisible rays, and found, that at a distance of two inches beyond visible red, his thermometer, in a few minutes, acquired $1\frac{1}{4}$ degree of heat. The extent of the coloured spectrum at that time, or the line which answered to G Q in his figure, measured 2.997 inches. If two inches had been the whole of the extent of the invisible part, it might be stated to be in proportion to the visible one as 2 to 3; but we are to make some allowance for a small space required beyond the last ordinate, that the curve of the heating power drawn through it may reach the base; and indeed, at $2\frac{1}{4}$ inches beyond visible red, Dr. Herschel could still find $\frac{1}{2}$ degree of heat. It appears therefore sufficiently safe, to admit the base of the spectrum of heat A Q, to be to that of the spectrum of light G Q, as $5\frac{1}{4}$ to 3; or, conforming to the Newtonian figure before mentioned, the base of which is 3.3 inches, as $57\frac{3}{4}$ to 33. Now, if we assume for the maximum of heat, an ordinate of an equal length with that which was fixed upon for the maximum of light, it will give us a method of comparing the two spectra together. Accordingly, Dr. Herschel has drawn the several ordinates B, C, D, E, F, G, H, I, K, L, M, N, O, P, of such lengths as, from experiments made on purpose, it appeared they should be, in order to express the heat indicated by the thermometer, when placed on the base, at the several stations pointed out by the letters.

A mere inspection of the two figures, which have been drawn as lying upon one another, will enable us now to see how very differently the prism disperses the heat-making rays, and those which occasion illumination, over the areas ASQA, and GRQG, of our two spectra! These rays neither agree in their mean refrangibility, nor in the situation of their maxima. At R, where we have most light, there is but little heat; and at S, where we have most heat, we find no light at all!

REFRESHMENT, *Quarters of*. See **QUARTERS**.

REFRET, *Fr.* the burden of a song. This word is only to be found in the second folio edition of Bailey's Dictionary, 1736. In no French dictionary is there authority for it. Cotgrave, Dict. du Vieux Langage; Tre-voux, Dict. de l'Académie; and Glossaries, have been consulted in vain.

REFRIGERANT, **REFRIGERATIVE**, in *Medicine*, or *coolings* from *frigus*, *cold*, an appellation given to such remedies as were supposed to possess a power of cooling the internal parts. Hence all diluents, such as ptisan, gruel, and other thin drinks, vegetable and mineral acids, neutral salts, and other substances, which are destitute of stimulating qualities, and communicate a sensation of coolness to the tongue and throat, have been considered as refrigerant. As they have no actual power of generating cold in the animal body, the term is somewhat incorrect; but as it expresses the opposite quality to that of stimulating, which is used also as synonymous with *heating*, it is still retained, and applied to diet, drink, and medicine of a non-stimulant quality. In this sense, the term is nearly synonymous with *sedative*.

Whatever, in fact, increases the circulation, increases the heat of the body, and *vice versa*; potentially, therefore,

all sedative medicines may be said to be refrigerant. The use of refrigerants will thence be inferred to be proper in all those cases in which there is an over-excitement of the circulation, either locally or generally; such as local inflammations, febrile diseases, hæmorrhages, and the like. In the case of external inflammations, indeed, actual refrigeration may be produced, by the application of cold substances, water or ice, or by the abstraction of heat by means of evaporation; both of which afford the means of directly diminishing the activity of the vessels of the part. Thus, in burns and scalds, the pain is instantly relieved, and the inflammation effectually reduced, by the immersion of the part in cold water, if sufficiently persevered in. But in respect to internal refrigerants, their operation is of a negative kind, and consists rather in the removal of uneasy sensations, and in the exclusion of stimulant substances, than in the actual suppression of increased action. See **SEDATIVE**.

REFRIGERATION, denotes the act of cooling, or the abstraction of heat from various substances. This is effected in a variety of ways, and for various purposes of domestic use and of art; and the degree of cold that is produced is estimated by an instrument called the *thermometer*, which see. Under this head it is needless to repeat the principles of refrigeration, and the different processes that are used for this purpose, which are amply stated and described under the articles **COLD**, **CONGELATION**, **COOLING**, **FREEZING**, **HEAT**, **ICE**, *Ice-houses*, &c.

REFRIGERATORY, **REFRIGERATORIUM**, in *Chemistry*, a copper vessel filled with cold water, soldered round the capital of an alembic, to cool and condense the vapours raised thither by the fire, and to convert them into a liquor, to be discharged thence through the beak. See **ALEMBIC**.

The water in the refrigeratory is to be changed from time to time, as it begins to grow warm.

Sometimes they content themselves with wrapping a wet cloth about the head of the alembic, instead of a refrigeratory; but the more usual method now is, to supply the place of the refrigeratory by a worm, or spiral pipe, running through a tub of cold water.

Distillation chiefly consists in evaporation and refrigeration. See **DISTILLATION**.

REFUGE, **REFUGIUM**, in our *Old Customs*, a *sanctuary*, or *asylum*; which see respectively.

At Paris there is an hospital called the *Refuge*, in which dissolute women are shut up.

REFUGE, *Cities of*, in *Scripture History*, six cities selected from the 48 appropriated to the residence of the Levites, which were appointed for the protection of persons from the rigour of the law, who were chargeable with involuntary homicide. Some have supposed that all the cities of the Levites were asylums; but it appears from Numb. xxxv. 6. that only six of them were appointed to this use. These asylums were intended not only for Jews, but for Gentiles, or for strangers who dwelt among them. (Numb. xxxv. 15.) They were not denoted as sanctuaries for wilful murderers and all sorts of atrocious villains among the Jews, as they were among the Greeks and Romans, and as such places have since been in Roman Catholic countries, but merely for securing those who had been guilty of involuntary homicide (Deut. xix. 4—10.) from the effects of private revenge, until they were cleared by a legal process. It is observable, that the Israelites are commanded to "prepare the way," that is, to make the road good, "that every slayer may flee thither," without impediment, and with all expedition. (Deut. xix. 3.) By having good roads to them, at least 32 cubits, or about 48 feet in breadth, and bridges wherever

wherever they were necessary, these cities were to be easy of access; and at cross roads posts were erected with inscriptions, directing the way to the "city of refuge." Upon this Hottinger remarks, that it was probably in allusion to this custom, that John the Baptist is described as "the voice of one crying in the wilderness, prepare ye the way of the Lord, make his paths straight." (Luke, iii. 4—6.) He was the Messiah's forerunner, and in that character was to remove the obstacles to men's flying to him as their asylum, and obtaining σωτηριαν τῷ θεῷ, the salvation of God. Every year, on the 15th of Adar, (February,) the magistrates were to inspect the roads, and ascertain their good condition. These cities were to be supplied with water and provisions; but they were not to be the residence of any artists who made weapons, by the use of which the relations of the deceased might gratify their revenge. It was necessary that those who took refuge in these places should understand some occupation, that might prevent their being chargeable, whilst they were waiting for their trial. In order to excite and maintain the greater horror even of involuntary bloodshed, the law punished it by a kind of banishment, for the accused person was to remain in this city, without departing from it, till the death of the high-priest, but after the high-priest's death, he might safely go wherever he pleased.

REFUGEES, French Protestants, who, by the revocation of the edict of Nantes, in 1685, have been constrained to quit their country, and retire for refuge into Holland, Germany, England, &c. to save themselves from the necessity of abandoning their religion.

REFUGIO, *EL*, in *Geography*, a harbour in one of the islands of Mayorga, where Maurelle was supplied with water in 1781, and which, he says, affords shelter from the most furious winds. S. lat. 18° 36'. E. long. 177° 32'.

REFVINGE, a town of Sweden, in the province of Halland; nine miles N.N.W. of Helsingland.

REFUSAL, in *Law*, is where one hath by law a right and power of having or doing something of advantage to him, and he declines it. An executor may refuse an executorship: but the refusal ought to be before the ordinary; if an executor be summoned to accept or refuse the executorship, and he doth not appear upon the summons and prove the will, the court may grant administration, &c. which shall be good in law till such executor hath proved the will; but no man can be compelled to take upon him the executorship, unless he hath intermeddled with the estate. (1 Leon. 154. Cro. Eliz. 858.) Where there are several executors, and they all refuse, none of them shall administer afterwards; but if there is a refusal by one, and the other proves the will, the refusing executor may administer when he will, during the life of his co-executor. (1 Rep. 28.) If there is but one executor, and he administers, he cannot refuse afterwards, and if once he refuse, he cannot administer afterwards.

There is a refusal of a clerk presented to a church, for want of literature, &c. and if a bishop once refuses a clerk for insufficiency, he cannot accept of him afterward, if a new clerk is presented. (5 Rep. 58. Cro. Eliz. 27.) In action of trover and conversion, a demand of the goods, and refusal to deliver them must be proved, &c. 10 Rep. 56.

REFUTATION, *REFUTATIO*, in *Rhetoric*, that part of the answer made to an opponent, which disproves what had been advanced by him.

REGA, in *Geography*, a river of Pomerania, which rises three miles N.W. of Dramburg, passes by Regenwalde, Plate, Grieffenberg, Treptow, &c., and then runs into the sea, 12 miles S.W. of Colberg.

REGAH, a town of Egypt, on the left bank of the Nile; six miles N. of Atfieh.

REGAL, *Regius*, or *Regalis*, something belonging to a king. Regal is of the same import with royal; the former being formed of the Latin *rex*; the other of the French *roy*, *king*.

REGAL, *Fr.*, a musical term, which the *Encyclopédie* defines, "as *fiffl*, an ancient instrument composed of many flutes of sonorous wood of different lengths, forming a scale, played upon by an ivory ball fastened to the end of a stick." This is exactly the description of the *sticcado*, said to be invented by the brother of Bremner, the late music-seller in the Strand, who published a book of instructions for playing upon it.

"Regal is, *secondly*, a spinet organized, or rather a small organ of two or three stops placed under a keyed instrument, very common in Spain and Italy. In France this kind of instrument is called a *positif*." Craing, an organ-builder in London about the middle of the last century, furnished organs of this kind to many harpsichords and spinets in a virginal form. Snetzler, when he first came hither from Strasburg, was employed by Shudi to organize his harpsichord.

But regal in all Roman Catholic countries is a portable organ used in processions, carried by one person and played by another. We have seen that use made of this kind of organ at Naples. The pipes are of reeds, for the lightness of carriage.

In the list of Edward VI. and queen Elizabeth's musical establishments in the Sloane MSS. at the British Museum, among the instrument-makers, the regal-maker is allowed 20*l.* yearly. And in our own memory there was an office in the chapel royal under the title of "tuner of the regals;" but it was abolished, and united to some more useful officer in the chapel.

In the supplement to the folio *Encyclopédie*, we are told that the regal is a portable organ, which has no pipes, or at most such as are very short, the tones being produced by reeds. This we believe to be the truth. The instrument is sometimes so small as to be set on a table.

REGAL *Fish*. See *ROYAL Fish*.

REGAL *Suit*. See *SUIT*.

REGALE, in the French *Jurisprudence*, is a right belonging to the king over all benefices in that kingdom.

The regale consists in enjoying the revenues of bishoprics, during the vacancy of their sees, and of presenting to the benefices dependent on them, which become vacant during that time, and till such a successor have taken the oath of fidelity, and have procured letters patent, to secure him from the regale.

The enjoyment of the fruits of the see is called the *temporal* regale; that of presenting the benefices, the *spiritual* regale.

Some refer the origin of the regale to the time of Clovis; and say, the clergy granted this privilege to the king upon his defeating the Visigoths; others allege, that pope Hadrian I. gratified Charlemagne with it, in a council held at Rome. It is observed by others, that the regale was originally no more than a ward, or administration; and that the kings were only depositaries of the fruits of the vacant bishoprics; and appointed æconomi to look to them during the vacancy.

It is added, that the kings of the first and second race never enjoyed any such privilege; and that it was only introduced in the twelfth century, in favour of investitures.

Whatever was the origin of the regale, it occasioned a

very important and warm debate between Lewis XIV. and pope Innocent XI. which began about the year 1678, and was carried on with great animosity and contention for several years after. Lewis was desirous, that all the churches in his dominion should be subject to the regale. Innocent pretended, on the contrary, that his claim could not be granted with such universality; nor would he consent to any augmentation of the prerogatives of this nature that had formerly been enjoyed by the kings of France. Lewis summoned, for settling this dispute, the famous assembly of thirty-five bishops, and as many deputies of the second order, which met at Paris in the year 1682, and which extended the regale to all the churches in France, without exception. In this convocation the ancient doctrine of the Gallican church, that declares the power of the pope to be merely spiritual, and also inferior to that of a general council, was drawn up in four propositions, which were solemnly adopted by the whole assembly, and were proposed to the whole body of the clergy, and to all the universities through the kingdom, as a sacred and inviolable rule of faith.

REGALE, *Regalia*, a magnificent treat, or entertainment, given to ambassadors, or other persons of distinction, to entertain or do them honour.

In Italy it is usual at the arrival of any traveller of eminence, to send him a regale, that is, a present of fruits, sweetmeats, &c. by way of refreshment.

REGALIA, in *Law*, the royal rights or prerogatives of a king.

These are reckoned by civilians to be six. 1. Power of judicature. 2. Power of life and death. 3. Power of war and peace. 4. Masterless goods, as waifs, estrays, &c. 5. Assessments. 6. Minting of money.

REGALIA is also used for the several parts of the apparatus of a coronation: as the crown, the sceptre with the cross, sceptre with the dove, St. Edward's staff, four several swords, the globe, and the orb with the cross, &c. used at the coronation of our kings.

REGALIA *of the Church*, are those rights and privileges which cathedrals, &c. enjoy by grants, and other concessions of kings.

Regalia is sometimes also used for the patrimony of a church; as, *regalia Sancti Petri*. And more particularly, for such lands and hereditaments as have been given by kings to the church.

"Cæpinus in manum nostram baroniam et regalia quæ archiepiscopus Eborum de nobis tenet." Pryn. Lib. Ang.

These regalia, while in possession of the church, were subject to the same services as all other temporal inheritances; and after the death of the bishop they reverted to the king, till he invested another with them; which, in the reigns of William the Conqueror, and some of his immediate successors, was frequently delayed, and as oft did the bishops make complaint of it, as appears from Malmshbury, Neubrigenfis, &c.

This last author says, that great complaint was made against Henry II. "Quod episcopatus vacantes, et provenientia perciperet commoda, diu vacare voluit, et ecclesiasticis potius usibus applicanda in fiscum redegit."

REGALIA *Facere* is used for the bishop's doing homage, or fealty, to the king, when he is invested with the regalia. Thus Malmshbury, in Anselm: "Regalia pro more illius temporis faciens principi vii. kalend. Octobris Cantuariæ affedit."

REGALITIES. See ROYALTIES.

REGAN, in *Geography*, a town of Persia, in the province of Kerman, and district of Nurmantheer, on the

frontier of Kerman to the east, which district is about 90 miles in length, and in breadth from 30 to 80. This district is bounded on the N. and S. by a range of mountains, those to the S. being covered with snow during the greater part of the year. The soil is fertile, the district populous, and well watered by streams from the mountains, and the climate hot in the plain, but cold on the mountains. The Afghans were lately expelled from this district by the Persians, who invited different tribes of Balouches to occupy the deserted villages.

Regan is a neat little town, surrounded by a mud wall, within which the cattle of the inhabitants are driven every night for protection. The fort is quadrangular, the walls high and in good repair, and flanked with bastions; with one gate, constantly guarded for preventing the entrance of strangers. The capital of Nurmantheer is Krook, which is the residence of the governor, and built in the same style as Regan, but larger, and surrounded by a deep ditch. Before the expulsion of the Afghans, a city, called Bumm, was considered as the frontier town of Persia in this quarter. This city is strongly fortified by a high mud wall, flanked with towers, surrounded by a deep and broad dry ditch, with one gate; and it has a bazar tolerably supplied with dates, milk, and fruit. The ruins of Bumm testify that it was formerly of much greater extent than it is at present. The fountains are said to have thrown water to an amazing height, and the gardens, which appear to have been walled in, and adorned with elegant summer-houses, produce the most delicious pomegranates. Kinneir's Geog. Memoir of the Persian Empire, 1813.

REGARD *of the Forest*, the oversight, or inspection, of it; or the office and province of the regarder; which is, to go through the whole forest, and every bailiwick of it, before the holding of the sessions of the forest, or justice-seat, to see and enquire of the trespasses in it, and for the survey of dogs. A court for this purpose is to be holden every third year. See EXPEDITION, and FOREST.

"Ad vivendum, ad inquirendum, ad certificandum, &c." See REGARDER.

REGARD is also used for the extent of the regarder's charge, *i. e.* for the whole forest; or all the ground that is parcel of it.

REGARDANT, in *Heraldry*, is understood of a lion, or other beast of prey, borne in a posture of looking behind him, with his face towards his tail.

Others apply it to a beast, which only shews the head, and some part of the neck, as moving from out of some division of the coat into another. He bears azure, three bends, or, in a chief, argent, charged with a lion regardant, gules.

REGARDANT *Villain*, or *Regardant to the Manor*, denotes an ancient servant or retainer to the lord; thus called, because charged to do all base services within the manor, to see the same freed of all filthy and loathsome things that might annoy it, &c. Coke upon Littleton, fol. 120.

REGARDER *of a Forest*, *Regardator Forestæ*, an ancient officer of the king's forest, whose business was every year, upon oath, to make a regard, *i. e.* to take a view of the forest limits; also to enquire of all offences and defaults committed by the foresters within the forest, and of all the concealments of them; and whether all the other officers did execute their respective duties or not.

Manwood refers this institution to king Henry II. but Spelman thinks the name, at least, was given since; and that they were the same with those officers called *custodes venationis*.

REGATTA is a name given at Venice to a kind of exhibition on the water, in which the gondoliers contend for superiority in the art of rowing their gondolas.

A splendid entertainment, under this appellation, was exhibited on the Thames in 1775.

REGAU, in *Geography*, a town of Austria; 12 miles W. of Steyr.

REGE INCONSULTO, in *Law*, is a writ issued from the king to the judges, not to proceed in a cause which may prejudice the king, until he is advised. A *rege inconsulto* may be awarded, not only for the party to the plea, but upon suggestion of a stranger, on cause shewn that the king may be prejudiced by the proceeding, &c.

REGE Querela Coram. See **QUERELA**.

REGEL, or **RIGEL**, in *Astronomy*, a fixed star of the first magnitude, in Orion's left foot.

REGELSBRUN, in *Geography*, a town of Austria; seven miles N. of Brugg.

REGEN, a river which rises on the borders of Bohemia, and runs into the Danube, near Ratibon.—Also, a town of Bavaria, on the above-named river; 40 miles E. of Ratibon.

REGENERATED TARTAR. See **TARTAR**, *Regenerated*.

REGENERATION, in *Theology*, the act of being born again by a spiritual birth, or becoming a child of God; or it is that change of heart and life experienced by a person, who forsakes a course of vice, and sincerely embraces a life of piety and virtue.

When an infidel is converted, baptism is always administered as a sign of regeneration.

The term is also used to signify the change of state that takes place at the resurrection. Matt. xix. 28.

REGENSBURG, in *Geography*, a town of Switzerland, in the canton of Zurich, situated on a mountain, and surrounded with walls in the year 1687; it is the principal place of a bailiwick formerly subject to the dukes of Austria; 6 miles E. of Baden.

REGENSBURG. See **RATIBON**.

REGENSTAUF, a town of Bavaria, in the principality of Neuburg; seven miles N. of Ratibon.

REGENSTEIN, a town of Westphalia, in the bishopric of Halberstadt; seven miles W. of Quedlinburg.

REGENSTORF, or *Old Regensberg*, a bailiwick of Switzerland, in the canton of Zurich, which derives its name from that of an ancient castle, destroyed in 1443.

REGENT, **REGENS**, a person who governs a kingdom during the minority or absence or incapacity of a king.

In France, the queen-mother has the regency of the kingdom, under the title of *queen-regent*, while the king is a minor. Some have urged, that women, being incapable of succeeding to that crown, were incapable of the regency; but custom has declared in their favour.

REGENT is also used for a professor of arts and sciences, who holds a class, or set of pupils, in a college.

The foreign universities are generally composed of doctors, professors, and regents. Regent and scholar are relative terms. See **TUTOR**.

Regent is generally restrained to the lower classes, as regent of rhetoric, regent of logic, &c.; those of philosophy are rather called professors.

REGENWALDE, in *Geography*, a town of Hinder Pomerania, on the Rega; 30 miles N.N.E. of Stargard. N. lat. 53° 49'. E. long. 15° 24'.

REGENDARIUS, among the Romans, an officer who subscribed and kept a register of all petitions presented to the præfect. *Pitisc. in voc.*

REGESTOLA, in *Ornithology*, a name used by some authors for the mattagels, or larger butcher-bird, a very small hawk, not exceeding the size of a common thrush, but very fierce and voracious. See **LANIUS Excubitor**.

REGETZ, in *Geography*, a town of Hungary; 18 miles S. of Csechau.

REGGE, a river of Holland, which rises near Enschede, and after passing by Ghoer, Ryfen, &c. joins the Vecht near Ommens.

REGGIO, PIETRO, in *Biography*, a native of Genoa, who seems to have been the first Italian who gave our country a taste for the vocal refinements of his country. Before his arrival here, he had been in Spain, Germany, Sweden, and France. Besides refinements in florid song, he was much admired for his exquisite manner of accompanying himself on the lute. His first residence in England was at Oxford, where he published, in 1677, a small tract, entitled "A Treatise to sing well any song whatever." In 1684 his book of songs, in folio, the words chiefly from Cowley, appeared. We know not what were the taste and expression which rendered his vocal powers so captivating; but his airs are very dry and monotonous, and in as old an Italian taste as those of Lulli.

REGGIO, in *Geography*, a city of Italy, capital of the department of the Crostolo, and formerly of the duchy of Modena, the see of a bishop, suffragan of Bologna. It was founded by the Tuscans, and became a Roman colony under Lepidus the triumvir. It was destroyed by Alaric, and rebuilt by Charlemagne. Its number of convents is 16, and of inhabitants about 18,000. The cathedral contains many capital pictures and sculptures. The inhabitants of this city were the first of all the Italians, who in 1794 renounced their allegiance to their own sovereign, Hercules III., who fled to Venice, afterwards took up arms, and solicited the protection of Bonaparte. He took possession of the city, proclaimed the liberty of the inhabitants, and instituted a legislative committee, who took the oath of allegiance to the French republic. Reggio is the native place of the poet Ariosto; 14 miles W.N.W. of Modena. N. lat. 44° 41'. E. long. 10° 38'.

REGGIO, a sea-port town of Naples, in Calabria Ultra, situated on the straits of Messina. The inhabitants carry on manufactures of stockings, gloves, and waistcoats of thread or silk. This place is the see of an archbishop, founded by the patriarch of Constantinople, and contains two colleges and seven convents. The environs abound in oranges, citrons, mulberries, and grapes, with some sugar-canes. This town was called by the Greeks *Rhegion*, derived according to Diodorus from the Greek word *ρηγνυμι*, to break or tear, because Sicily was torn from Italy, either by the sea or an earthquake. It is very ancient, founded as some say by Jocalrus, son of Æolus, king of Lipari, who entertained Ulysses; or, according to others, by the Chalcidians, who came hither from Eubœa. The territory of the Rhegini was free and powerful, though sometimes governed by tyrants. In the Peloponnesian war they suffered much from their neighbours the Epizephyrian Locri, and were distracted by internal contentions. In the time of Dionysius the elder they were very powerful and asserted their liberty, refusing an alliance with that tyrant, who demanded a daughter of the city. When Pyrrhus waged war against the Romans, the latter sent a legion for the protection of Rhegium; but the soldiers murdered the citizens and seized on the city. After the war the insurgents were taken by the Romans, and put to death for their treachery and cruelty. St. Paul, on his journey to Rome, passed through this city. In the year 1783 it was almost totally destroyed

by an earthquake; 10 miles S.E. of Messina. N. lat. $38^{\circ} 6'$. E. long. $16^{\circ} 53'$.

REGGIOLO, a town of Italy, in the department of the Mincio; six miles E. of Gualtalla.

REGHABILLE, a town of Africa, in the country of Wangara, situated on a lake. N. lat. $12^{\circ} 47'$. E. long. $18^{\circ} 19'$.

REGIA AQUA. See AQUA.

REGIA Via. See VIA.

REGIA Villa. See VILLA.

REGICIDE, REGICIDA, a *king-killer*. The term is also used for the act itself of murdering a king; of *rex*, *king*, and *caedo*, *I slay*.

Regicide is chiefly used with us in speaking of the persons concerned in the trial, condemnation, and execution, of king Charles I.

REGIFUGE, REGIFUGIUM, a feast held in ancient Rome on the sixth of the calends of March, *i. e.* on our 24th of February, in memory of the expulsion of their kings, particularly of Tarquin's flying out of Rome on that day. Some will have the feast to bear this name from the *rex sacrorum*, *king of the sacrifices*, flying out of the comitia, or place of assembly, as soon as the sacrifice was over, in imitation of the flight of Tarquin the Proud.

Some critics and antiquaries will have Regifugium the same with Fugalia; others hold them to be different.

REGIMEN, in *Medicine*, from *rego*, *I rule or govern*, a rule or course of living, with regard to eating, drinking, clothing, and the like, accommodated to some disease, or particular course of medicine which the patient is under, or intended as a prevention of some threatening malady.

In many diseases, especially those of the acute or febrile class, the regimen is often of equal, and sometimes of more importance than medicine: and there can be no doubt that the humoral physicians, by the introduction of a *hot* regimen in the treatment of febrile complaints, contributed to render these diseases more severe and fatal; and that the substitution of a cool regimen has of late years very materially diminished the danger and mortality of these maladies. This change in medical practice has been, in fact, but a return to nature, and to Hippocrates, who taught this simple, but clear and rational principle, "*contraria contrariis medentur*;" remedies should be of an opposite nature to diseases: that is to say, if the body is morbidly hot, cold is the remedy; if it is cold, the application of heat is necessary; if there is over-distention, inflammation, or plethora, evacuation must be resorted to: if depletion, we must supply nourishment: if there is thirst, the remedy is the free use of drink, and so forth. The clear instincts of nature (where they can be distinguished) are commonly infallible guides, as to the regimen to be pursued: but let not morbid habits and prejudices be mistaken for them. Thus in *all fevers*, small-pox, measles, scarlet-fever, catarrh, typhus, and the plague itself, the natural bias is for fresh air, coolness, light bed-clothes, clean linen, cold drink, light and merely liquid nourishment, in small quantities, or absolute abstinence, quietness of mind and body, relief from noise, strong light, and every species of excitement; and this is precisely the regimen, which experience has proved to be most beneficial in such diseases. Under the influence of such a regimen, where proper medicines are also employed, every symptom is rendered comparatively mild; the distress of the sick is diminished, by the soothing of every morbid sensation; and the derangements, which would otherwise ensue, or be aggravated, in the more vital organs, as in the brain, lungs, and alimentary canal, are frequently altogether prevented.

It is sufficient to contrast the effects of the hot regimen, in febrile diseases, to be convinced of the truth of these observations. When a person afflicted with any species of fever, is confined in a close and heated apartment, in which the free circulation of air is prevented by closed doors and windows, curtains, &c. and is kept at the same time under a load of bed-clothes, and supplied with hot drinks, or even cordials of vinous and fermented liquors, with the view of inducing perspiration, the consequences are as follow. The whole train of symptoms is aggravated. The heat of the patient is raised considerably above the natural standard, notwithstanding the profuse perspirations that are constantly bathing him; the pulse is excited to the highest febrile standard; the thirst becomes incessant to supply the unnatural waste of fluids; the mouth and lips become parched and furred; the head is in constant pain, with confusion of ideas, preventing all sound sleep, and occasioning distressing dreams, and at length delirium; the whole powers of the frame become prostrate, with disposition to fainting, on being moved, or on passing an evacuation by stool; and from this situation the recovery is extremely precarious. In cases of contagious fever, such as small-pox, measles, scarlet-fever, &c., the eruption is always greatly multiplied by this hot regimen, and all the symptoms are changed to what has been called a putrid type; the tongue, teeth, and lips, become coated with a black, clammy, and immovable fur; purple spots appear on the skin; and the whole disease assumes the character of malignancy. There is one disease, indeed, which is solely the result of this hot regimen, which has made a considerable figure in the writings of physicians, who never dreamt that it was of their own creation; we allude to the *miliary fever*. See MILIARIA.

The above may perhaps be considered as the extreme of the picture, which is scarcely ever to be seen in the present day. But the greatest difficulty which a physician has even now to overcome, in the majority of cases of feverish diseases, is to counteract the tendency of nurses and parents to the adoption of more or less of this pernicious system. The salutary *chill* must be taken away from all liquids, whether used internally or externally; the cheering breeze is deemed a death-bringing draught; and though the patient may die from the severity of a malignant fever, he must on no account run the slightest risk of *catching cold*; that is to say, the possible occurrence of a slight sore-throat, or a running at the nose, is to be avoided religiously, at the expense of aggravating both the sufferings and the danger, under a more formidable disease. The use of wine and cordials, in these diseases, is now confined to the poor and ignorant, and it is to be hoped, that the other parts of the hot regimen will not long be resorted to, at least among the more intelligent classes of society. See COLD as a remedy.

REGIMEN, in *Chemistry* and *Alchemy*, is the method of ordering and conducting any thing, that it may answer its intention.

Thus, regimen of fire is the method of making and ordering fire, and the degrees of it.

REGIMEN of the Work, that is, of the philosopher's stone, called the *work of patience*, is the rule and conduct to be observed to obtain protection.

There are three things, they say, to be chiefly regarded in the regimen of the work. The first, to administer a gentle easy heat at the beginning of the coction.

The second, to continue this external heat according to the season of the work, always observing four seasons, as in the common and astronomical year; the beginning being the winter, the progress the spring, then summer, and lastly autumn, which is the time of maturity and perfection of the stone;

tion; in all which the heat is to be augmented in proportion to the augmentation observed in nature.

It is to be added, that the work may not be begun in any season; but regard is to be had to the seasons of nature. In the winter of the work be found in the summer of the year, &c. Which, however, is to be understood of the day in which the mercury is put in the ovum philosophicum, not of that when it is begun to be set at liberty from the prisons which nature had inclosed it in.

The third is, that in augmenting the fire, the augmentation be not of a whole degree at once, the spirits being unable to bear such violence; but a degree is to be divided into four parts, and one part is to be taken at a time.

All the operations of the first regimen are occult and invisible: in the second regimen comes putrefaction, which, they say, is the first sensible change, shewing itself by its black colour.

REGIMEN, or *Government*, in *Grammar*, is that part of syntax or construction, which regulates the mutual dependency of words, and the alterations which one part of speech occasions in another, with regard to its mood, tense, or case, and thus it differs from concord, or the agreement which one word has with another, in gender, number, case, or person. See CONCORD.

The regimen, or government, is entirely arbitrary, and differs in all languages; one language forming its regimen by cases, as the Latins and Greeks; others by particles in lieu of them, as the English by *of*, *to*, &c. the French, Spaniards, and Italians, by *de*, *a*, *di*, &c.

There are, however, some general maxims which hold good in all languages; as, 1. That there is no nominative case in any sentence but has a reference to some verb, either expressed or understood. Sometimes, indeed, the infinitive mood, or part of a sentence, is put as the nominative case to the verb; as in English, "to see the sun is pleasant." These sentences, or clauses, thus constituting the subject of an affirmation, may be termed "nominative cases."

2. That there is no verb, except in the infinitive mood, or the participle, but has its nominative case, either expressed or understood. Indeed, in languages which have proper accusatives, as the Latin, before infinitives there is an accusative, not a nominative case; as *Scio Petrum esse doctum*. The nominative case is commonly placed before the verb; but sometimes it is put after the verb, if it is a simple tense; and between the auxiliary and the verb, or participle, if a compound tense.

3. Two or more nouns, &c. in the singular number, joined together by one or more copulative conjunctions, expressed or understood, must have verbs, nouns, and pronouns, agreeing with them in the plural number. The conjunction disjunctive, however, has an effect contrary to that of the conjunction copulative; for as the verb, noun, or pronoun, is referred to the preceding terms, taken separately, it must be in the singular.

4. A noun of multitude, or signifying many, may have a verb or pronoun agreeing with it, either of the singular or plural number; but not without regard to the import of the word, as conveying unity or plurality of idea. In the application of this rule, we ought to consider whether the term immediately suggests the idea of the number it represents, or whether it exhibits to the mind the idea of the whole as one thing. In the former case, the verb ought to be plural; in the latter, it ought to be singular.

5. Pronouns must always agree with their antecedents, and the nouns for which they stand, in gender and number.

6. The relative is the nominative case to the verb, when

no nominative comes between it and the verb; but when a nominative comes between the relative and the verb, the relative is governed by some word in its own member of the sentence; *e. gr.* "he *who* preserves me, to *whom* I owe my being, *whose* I am, and *whom* I serve, is eternal."

7. When the relative is preceded by two nominatives of different persons, the relative and verb may agree in person with either, according to the sense.

8. Every adjective, and every adjective pronoun, belongs to a substantive, expressed or understood. Adjective pronouns must agree in number with their substantives; nevertheless this rule admits of exceptions; *e. gr.* the word *means* in the singular number, and the phrases "by this means," "by that means," are used by our best and most correct writers, *viz.* Bacon, Tillotson, Atterbury, Addison, Steele, Pope, &c. Campbell, in his "Philosophy of Rhetoric," has this remark on the subject before us: "No persons of taste will, I presume, venture so far to violate the present usage, and consequently to shock the ears of the generality of readers, as to say 'by this mean,' 'by that mean.'" Lowth and Johnson seem also to be against the use of *means* in the singular number. The distributive adjective pronouns, *each*, *every*, *either*, agree with the nouns, pronouns, and verbs of the singular number only. Adjectives are sometimes improperly applied as adverbs. An adjective pronoun, in the plural number, will sometimes properly associate with a singular noun. Although the adjective always relates to a substantive, it is, in many instances, put as if it were absolute, especially where the noun has been mentioned before, or is easily understood, though not expressed. Substantives are often used as adjectives: in this case, the word so used is sometimes unconnected with the substantive to which it relates; sometimes connected with it by a hyphen; and sometimes joined to it, so as to make the two words coalesce. Sometimes the adjective becomes a substantive, and has another adjective joined to it. When an adjective has a preposition before it, the substantive being understood, it takes the nature of an adverb, and is considered as an adverb.

9. One substantive governs another, signifying a different thing, in the possessive or genitive case; inasmuch as that case always expresses the possessor, which must be governed by the possessed: as, "my father's house," "virtue's reward," &c. When the annexed substantive signifies the same thing as the first, and serves merely to explain or describe it, there is no variation of case; as "George, king of Great Britain, elector of Hanover, &c." Nouns thus circumstanced are said to be in *apposition* to each other: and nouns are not unfrequently set in apposition to sentences, or clauses of sentences. This rule does not hold so apparently in the modern as it does in the ancient languages; because the particles *of*, *de*, &c. which are the proper signs of the genitive case, are frequently used as prepositions. (See GENITIVE.) Substantives govern pronouns as well as nouns in the possessive case; as "every tree is known by *its* fruit." Sometimes a substantive in the genitive or possessive case stands alone, the latter one by which it is governed being understood. The English genitive has often an unpleasant sound, so that we make more use of the particle *of* to express the same relation: and in some cases, we use both the genitive termination and the preposition *of*; as "it is a discovery of sir Isaac Newton's:" but when this double genitive, as some grammarians call it, is not necessary to distinguish the sense, and especially in a grave style, it is generally omitted. Except to prevent ambiguity, it seems to be allowable only in cases which suppose the existence of a plurality of subjects of the same kind, as "a subject of the emperor's." But after all that can be said for the double genitive, as it is termed,

termed, it is the opinion of some grammarians, that it would be better to avoid the use of it altogether, and to give the sentiment another form of expression.

10. Active verbs govern the objective (or accusative) case, as "Virtue rewards her followers." In English, the nominative case, denoting the subject, usually goes before the verb; and the objective case, denoting the object, follows the verb active; and it is this order that determines the case in nouns; as, "Alexander conquered the Persians:" but the pronoun having a proper form for each of those cases, is sometimes, when it is in the objective case, placed before the verb; and when it is in the nominative case, follows the object and verb; as "whom ye ignorantly worship, him declare I unto you." Verbs neuter do not act upon, or govern, nouns and pronouns. Part of a sentence, as well as a noun or pronoun, may be said to be in the objective case, or to be put objectively, governed by the active verb; and sentences or phrases under this circumstance may be termed "objective sentences or phrases." The verb *to be*, through all its variations, has the same case after it as that which next precedes it; so that this substantive verb has no government, or case, but serves, in all its forms, as a conductor to the two cases, inasmuch that the two cases which, in the construction of the sentence, are the next before and after it, must always be alike. Passive verbs which signify naming, and others of a similar nature, have the same case before and after them; as "*he* was called *Cæsar*." It is evident also, that certain other neuter verbs, besides the verb *to be*, require the same case, whether it be the nominative or the objective, before and after them; such verbs are, to become, to wander, to go, to return, to appear, to die, to live, to look, to grow, to seem, to roam, and several others. The auxiliary *let* governs the objective case; as "let *him* beware."

11. One verb governs another that follows it, or depends upon it, in the infinitive mood; as, "cease *to do* evil," "learn *to do* well;" and the preposition *to*, though generally used before the latter verb, is sometimes properly omitted; as "I heard him say it," instead of "*to say* it." This irregularity extends only to active or neuter verbs: for many other verbs, when made passive, require the preposition *to* before the following verb; as "He was seen *to go*." The infinitive is frequently governed by adjectives, substantives, and participles; and this mood has much of the nature of a substantive, expressing the action itself which the verb signifies, as the participle has the nature of an adjective, so that the infinitive mood does the office of a substantive, in different cases, as in the nominative, "*to play* is pleasant," and in the objective, "boys love *to play*." The infinitive mood is often made absolute, or used independently on the rest of the sentence, supplying the place of the conjunction *that* with the potential mood, as "to confess the truth, I was in fault." The preposition *to*, signifying *in order to*, was anciently preceded by *for*, as "what went ye out *for to see*;" but the word *for* before the infinitive, is now, in almost every case, obsolete.

12. In the use of words and phrases which, with respect to time, relate to each other, a due regard to that relation should be observed. Thus, instead of saying, "the Lord *bath* given, and the Lord *bath* taken away," we should say, "the Lord *gave*, and the Lord *bath* taken away." To preserve consistency in the time of verbs, and also of words and phrases, says Mr. L. Murray, in his excellent treatise on Grammar, we must recollect that, in the subjunctive mood, the present and the imperfect tenses often carry with them a future sense; and that the auxiliaries *should* and *would*, in the imperfect time, are used to express the present and future, as well as the past. With regard to verbs

in the infinitive mood, says the same popular author, the practice of many writers, among whom are some of the most respectable, appears to be erroneous. They seem not to advert to the true principles which influence the different tenses of this mood. The following rules will, according to our author's judgment, be found perspicuous and accurate. "All verbs expressive of hope, desire, intention, or command, must invariably be followed by the present, and not the perfect of the infinitive." Instead of the phrase, "the last week I intended to *have written*," though common, the infinitive being in the past time, as well as the verb which it follows, it ought to be, "the last week I intended *to write*:" for how long soever it now is since I thought of writing, "to write" was then present to me, and must still be considered as present, when I bring back that time, and the thoughts of it. Some writers on grammar, however, maintain that the former sentence is correct and grammatical, because, as they assert, it simply denotes the speaker's intention to be hereafter in possession of the finished action of writing; but this reasoning admits of the following answers, according to the statement of Mr. Murray. The phrase "to have written" is, in English grammar, the established past tense of the infinitive mood, and as incontrovertibly the past tense of the infinitive in English, as *scripsisse* is the past tense of the infinitive in Latin; nor can any writers be warranted in taking such liberties with the language, as to contradict its plainest rules, for the sake of supporting an hypothesis. Moreover, these writers might, on their own principles, and with equal propriety, contend, that the phrase "I intended *having written*," is proper and grammatical; but by admitting such violations of established grammatical distinctions, confusion would be introduced, the language would be disorganized, and the most eccentric systems of grammar might be advanced, and plausibly supported. In short, says our author, the phrase "I intended to have written," appears to involve the following absurdity; "I intended to produce hereafter an action or event, which has been already completed." Some may hastily infer from the rule above stated, and from the near relation between the verbs *to desire*, and *to wish*, that the latter verb, like the former, must invariably be followed by the present of the infinitive. But when any one considers, that the act of *desiring* always refers to the future, and that the act of *wishing* refers sometimes to the past, as well as sometimes to the future, he will perceive the distinction between them, and that, consequently, the following modes of expression are strictly justifiable: "I wished *that I had written* sooner," "I wished *to have written* sooner;" and he will be perfectly satisfied, that the following phrases must be improper: "I desired that I had written sooner," "I desired to have written sooner." Mr. Murray, having considered and explained the special rule, respecting the government of verbs, expressive of hope, desire, intention, or command, proceeds to state and elucidate the general rule, on the subject of verbs in the infinitive mood. "This rule," he says, "is founded on the authority of Harris, Lowth, Campbell, Pickbourn, &c.; and we think, too, on the authority of reason and common sense. "When the action or event, signified by a verb in the infinitive mood, is *contemporary* or *future*, with respect to the verb to which it is chiefly related, the present of the infinitive is required; when it is *not* contemporary, *nor* future, the perfect of the infinitive is necessary." To comprehend and apply this rule, the student has only to consider, whether the infinitive verb refers to a time antecedent, contemporary, or future, with regard to the governing or related verb. When this simple point is ascertained, there will be no doubt in his mind, respecting the form

form which the infinitive verb should have. A few examples may illustrate these positions. If I wish to signify, that I rejoiced at a particular time, in recollecting the sight of a friend, some time having intervened between the *seeing* and the *rejoicing*, I should express myself thus: "I rejoiced *to have seen* my friend." The *seeing*, in this case, was evidently antecedent to the *rejoicing*; and therefore the verb which expresses the former, must be in the perfect of the infinitive mood. The same meaning may be expressed in a different form: "I rejoiced *that I had seen* my friend;" or, "in *having seen* my friend;" and the student may, in general, try the propriety of a doubtful point of this nature, by converting the phrase into these two correspondent forms of expression. When it is convertible into both these equivalent phrases, its legitimacy must be admitted.—If, on the contrary, I wish to signify, that I rejoiced at the sight of my friend, that my joy and his presence were contemporary, I should say, "I rejoiced *to see* my friend;" or, in other words, "I rejoiced *in seeing* my friend." The correctness of this form of the infinitive may also, in most cases, be tried, by converting the phrase into other phrases of a similar import.

The subject may be still further illustrated, by additional examples. In the sentence which follows, the verb is with propriety put in the perfect tense of the infinitive mood: "It would have afforded me great pleasure, as often as I reflected upon it, *to have been* the messenger of such intelligence." As the message, in this instance, was antecedent to the pleasure, and not contemporary with it, the verb expressive of the message must denote that antecedence, by being in the perfect of the infinitive. If, on the contrary, the message and the pleasure were referred to as contemporary, the subsequent verb would, with equal propriety, have been put in the present of the infinitive: as, "it would have afforded me great pleasure, *to be* the messenger of such intelligence." In the former instance, the phrase in question is equivalent to these words; "*if I had been* the messenger;" in the latter instance, to this expression; "*being* the messenger."

To assert, as some writers do, that verbs in the infinitive mood have no tenses, no relative distinctions of present, past, and future, is inconsistent with just grammatical views of the subject. That these verbs associate with verbs in all the tenses, is no proof of their having no peculiar time of their own. Whatever period the governing verb assumes, whether present, past, or future, the governed verb in the infinitive always respects that period, and its time is calculated from it. Thus, the time of the infinitive may be before, after, or the same as, the time of the governing verb, according as the thing signified by the infinitive, is supposed to be before, after, or present with, the thing denoted by the governing verb. It is, therefore, with great propriety, that tenses are assigned to verbs of the infinitive mood. The point of time from which they are computed is of no consequence; since present, past, and future, are completely applicable to them.

It may not be improper to observe, that though it is often correct to use the perfect of the infinitive after the governing verb, yet there are particular cases, in which it would be better to give the expression a different form. Thus, instead of saying, "I wish to have written to him sooner," "I then wished to have written to him sooner," "He will one day wish to have written sooner;" it would be more perspicuous and forcible, as well as more agreeable to the practice of good writers, to say; "I wish that I had written to him sooner," "I then wished that I had written to

him sooner," "He will one day wish that he had written sooner."

13. Participles have the same government as the verbs from which they are derived; as, "I am weary with *hearing* him," &c. It should be considered, however, that participles are sometimes governed by the article; for the present participle, with the definite article *the* before it, becomes a substantive, and must have the preposition *of* after it. This rule arises from the nature and idiom of our language, and from as plain a principle as any on which it is founded; namely, that a word which has the article before it, and the possessive preposition *of* after it, must be a noun; and, if a noun, it ought to follow the construction of a noun, and not to have the regimen of a verb. It is the participial termination of this sort of words that is apt to deceive us, and make us treat them as if they were of an amphibious species, partly nouns and partly verbs.

The same observations, which have been made respecting the effect of the article and participle, appear to be applicable to the pronoun and participle, when they are similarly associated. When a substantive is put absolutely, and does not agree with the following verb, it remains independent on the participle, and is called the "case absolute," or the "nominative absolute;" but when the substantive preceding the participle agrees with the subsequent verb, it loses its absoluteness, and is like every other nominative.

14. Adverbs, though they have no government of case, tense, &c. require an appropriate situation in the sentence, *viz.* for the most part, before adjectives, after verbs active or neuter, and frequently between the auxiliary and the verb.

15. Prepositions govern the objective case. Under this rule we may remark, that the prepositions *to* and *for* are often understood, chiefly before the pronouns, as "give me the book," *for to me*, &c. The preposition is often separated from the relative which it governs; as "whom will you give it to?" *for* "to whom will you give it?" Some writers separate the preposition from the noun or pronoun which it governs, in order to connect different prepositions with the same word; but this kind of construction is always inelegant, and should generally be avoided. Different relations, and different senses, must be expressed by different prepositions, though in conjunction with the same verb or adjective. Thus we say, "to converse *with* a person, *upon* a subject, *in* a house, &c." When prepositions are subjoined to nouns, they are generally the same that are subjoined to the verbs from which the nouns are derived. Many writers, as Dr. Priestley has observed, affect to subjoin to any word the preposition with which it is compounded, or the idea of which it implies, in order to point out the relation of the words, in a more distinct and definite manner, and to avoid the more indeterminate propositions *of* and *to*: but general practice, and the idiom of the English tongue, seem to oppose the innovation. Thus many writers say, "averse *from* a thing;" but others use "averse *to* it," which is more truly English: "Averse *to* any advice," Swift. "The words *averse* and *aversion*," says Dr. Campbell, "are more properly construed with *to* than with *from*." The examples in favour of the latter preposition are beyond comparison outnumbered by those in favour of the former. The argument from etymology is here of no value, being taken from the use of another language. If, by the same rule, we were to regulate all nouns and verbs of Latin original, our present syntax would be overturned. It is more conformable to English analogy with *to*; the words *dislike* and *hatred*, nearly synonymous, are thus construed."

16. Conjunctions connect the same moods and tenses of verbs,

verbs, and cases of nouns and pronouns, as "Candour is to be approved and practised."

17. Some conjunctions require the indicative, some the subjunctive mood, after them. Those that are of a positive and absolute nature belong to the former class; *e. g.* "As virtue advances, so vice recedes." When something contingent or doubtful is implied, the subjunctive ought to be used, as "If I were to write, he would not regard it." See SUBJUNCTIVE.

18. When the qualities of different things are compared, the latter noun or pronoun is not governed by the conjunction *than* or *as*, but agrees with the verb, or is governed by the verb or the preposition, expressed or understood; as "Thou art wiser than I," that is, "than I am."

19. For the purpose of avoiding disagreeable repetitions, and of expressing our ideas in few words, an ellipsis, or omission of some words, is frequently admitted; *e. g.* instead of saying "He was a learned man, he was a wise man, and he was a good man," we say, availing ourselves of the ellipsis, "He was a learned, wise, and good man."

20. All the parts of a sentence should correspond to each other; so that a regular and dependent construction may, throughout, be carefully preserved. The following sentence is inaccurate; "He was more beloved, but not so much admired, as Cinthio," it should be, "He was more beloved than Cinthio, but not so much admired."

21. The regimen of verbs is frequently laid on different kinds of relations, according to custom or usage; which yet does not change the specific relation of each case, but only shews, that custom has made choice of this or that, according to fancy. Thus the Latins say, *juvare aliquem*, and *epitulari alicui*, to help one. So the French say, *servir quelqu'un*, and *servir à quelqu'un*, to serve one. Thus the English say, *fight one*, or *fight with one*. And thus, in Spanish, most of the verbs active govern indifferently either a dative or an accusative. Sometimes, also, the verb admits of several regimens; as *præstare aliquem*, or *alicui*; *eripere morti aliquem*, or *aliquem à morte*.

Indeed, the different regimen sometimes makes an alteration in the sense; in which, particular regard is to be had to the usage of the language. Thus, the Latin *cavere alicui* signifies to watch, or be careful of the preservation of any one; *cavere aliquem* signifies to beware of him.

There is one very common fault in regimen, which our accurate writers should be careful to avoid; *viz.* the using of two verbs that require different cases together, as only governing one case; as in this example; after *embracing* and *giving his blessing to his son*; where *embracing* requiring an accusative, and *giving* a dative case, the regimen or construction of the first verb with the noun is irregular; *embrace to a son*.

The same may be observed in nouns; as, *I conjured him by the memory and the friendship he bore my father*; where *memory* does not agree with *he bore*.

For an ample illustration of these rules by appropriate examples, and also of the exceptions which pertain to each respectively, we refer to Mr. Murray's English Grammar, vol. i. ch. 12. See CONCORD and SYNTAX.

REGIMEN, or Construction, State of, *Status regiminis*, a phrase used by Hebrew grammarians in contradistinction to the absolute state, or *status absolutus*. A noun in *statu absoluto* is that which does not govern either a genitive or any oblique case; and it is said to be in *regimine* or in *constructione*, when it does govern such case. Nouns of the former kind seldom undergo any change in the letters that form them, as מלכים צדקים, just kings, whereas the latter either

lose one of their letters, or undergo a change of one into another; but these latter admit of excepted cases; *e. gr.* singular masculine nouns undergo no change in *regimine* מלך ארץ, king of the land, and plurals throw off the final letter, as מלכי ארץ, kings of the earth, for מלכים ארץ. This is also the case with participles, as פועל און, working iniquity, and פועלי און, workers of iniquity. Singular feminine nouns ending in ה change the ה in *regimine* into ת, as תורת יהוה, the law of the Lord; others, and especially plural nouns, undergo no change פלכת שמים, the kingdom of heaven. We shall here observe, that the change which takes place on account of the state of regimen is made in the governing noun, and not in that which is governed, contrary to the practice in other languages. For other particulars referring to regimen in Hebrew, as well as in Latin, Greek, and other learned languages, we refer to the article SYNTAX.

REGIMENT, derived from the Fr. *regie*, of *regere*, to govern, or from the Fr. *regime*, denoting system or administration, in *War*, a body consisting of several troops of horse, or companies of foot, commanded by a colonel, lieutenant-colonel, and major; or, as sir James Turner defines it, a certain number of companies joined in one body, under one head. A regiment of cavalry consists of one or more squadrons; and a regiment of infantry of one or more battalions.

The number of men in a regiment is as undetermined as that of the men in a troop, or company; in a squadron or battalion.

A battalion in each regiment of foot is divided into companies, but the number of companies is various; though, in England, our regiments are generally ten companies; two of which are called the flanks; one on the right, consisting of grenadiers, and another on the left, formed of light troops. The squadrons in cavalry, or in regiments of horse, are divided, sometimes into six, and sometimes into nine troops. Each regiment has a chaplain, quarter-master, adjutant, and surgeon. It has been suggested, that every regiment of foot should consist of 2400 men, making three battalions of 800 each.

Some German regiments consist of 2000 foot; and the regiment of Picardy in France consisted of 120 companies, or 6000 men.

The French have distinguished between the commanding officer of a regiment of cavalry, and the commanding officer of a regiment of infantry; the former having been called "maitre de camp," and the latter "colonel," as with us. According to the present establishment of the French army, the term "regiment" is confined to the cavalry and artillery, and the name of half brigade is given to the infantry, so that "chef de brigade," chief of brigade, corresponds with our colonel of a regiment of infantry. In the French cavalry the term colonel is still retained.

Some observe, that there were no regiments of horse before the year 1637. Till then the troops were loose and independent of each other, and not incorporated into a body or regiment.

Regiments, it is said, were first formed in France, under the reign of Charles IX. though F. Daniel refers them to the time of Henry II. and in England to the year 1660. Grose observes, that we may, without being very much mistaken, place the introduction of regiments and colonels about the reign of king Henry VIII.

We shall here annex a brief account of some of the principal regiments of the old corps. The first and second regiments of life-guards claim priority of notice. The life-

guards succeeded that body under the same denomination which was raised by Charles II., soon after the restoration, the privates of whom were taken from the cavalier gentlemen, who had adopted the profession of arms, and followed the fortunes of his father during the civil wars. As they were for the most part men of family, they possessed certain privileges, similar to those of the household troops in France, after whom they were modelled; and these privileges were continued long after the time when they ceased to be composed of the same class of men: It was, therefore, found necessary to reduce the privates, and to form a new corps, composed almost entirely of recruits under the old officers, and to place them nearly on the same footing with the rest of the cavalry; reserving for them, however, the advantages arising out of a higher pay, and an exemption from stoppages on the part of the privates, whose clothing is furnished by government. The life-guards claim the privilege, that their officers are not liable to be tried by any court-martial, unless the members are composed of their own regiment, or of officers of the other household troops. The first regiment of life-guards, consisting of very fine men, about 6 feet high at an average, was formed in 1788. The uniform is scarlet, faced with blue, and gold lace. The commissioned officers are a colonel, one lieutenant-colonel, one supernumerary lieutenant-colonel, two majors, five captains, six lieutenants, one adjutant and lieutenant, five cornets, one surgeon, and one veterinary surgeon. The non-commissioned officers consist of quarter-masters and corporals. The privates are about 260 in number. Their quarters are permanent at Knightbridge barracks. The second regiment is on the same footing with the first, and of the same establishment. The average height of the men is 5 feet 11 $\frac{3}{4}$ inches; the horses are from 16 to 18 hands high, of a black colour, with long tails. In this regiment, as well as the other, there are five troops; each troop consisting of one captain, one lieutenant, one cornet, one quarter-master, three corporals, 49 privates, including a farrier, and one trumpeter. Each regiment has one kettle drummer. The officers usually ride bay-horses; the kettle drummers and trumpeters, grey. There are two "gold-sticks," one appertaining to each regiment: their duty is to attend alternately every month on his majesty. See *LIFE-GUARDS*.

A body of foot-guards was not regularly organized on the present plan till after the restoration. The regiment of general Monk, created duke of Albemarle, was, in compliment to him, retained on the establishment, when most of the other troops were disbanded. This regiment had been raised about ten years before the period alluded to, at Coldstream, in Scotland; and from this circumstance it assumed the name, which it has borne ever since. The year 1660 may thus be considered as the era of the formation of the foot-guards; and though other regiments were added, the Coldstream had the priority. The guards possess many peculiar honours and privileges: they have precedence of all others; their officers possess a higher rank in the army; and without expence to themselves, when on guard at St. James, they have a plentiful table kept for them by the public, and voted annually in the extraordinaries of the army. The king's person, the royal family, the Tower, and, in times of danger, the bank of England, are in a particular manner under their protection. Their uniforms are royal, with blue facings, and their pay superior to that of the marching regiments. See *Foot-GUARDS*.

The corps, denominated the royal regiment of horse-guards, blue, commonly called Oxford blues, derives its appellation from the noble family of Oxford, who was its first colonel in 1661. This regiment has distinguished itself

on a variety of occasions. The following circumstances are peculiar to this corps. It is the only regiment, denominated "horse," at present on the British establishment. The promotions, that of colonel excepted, are restricted to the regiment. The quarter-masters' commissions are signed by the king, so that they are properly termed commission-officers; whereas in all the other cavalry, or dragoon regiments, quarter-masters are only warrant-officers. The average height of the men is 5 feet 10 $\frac{1}{2}$ inches. The uniform of the officers is blue, faced with scarlet, gold lace, and buff lining; of the privates, blue, with plain red lappets, very broad buff cross-belts, and gloves of the same colour. The troopers' horses are black, with long tails. The corps consists of nine troops; and to each troop belong four commissioned officers, five non-commissioned officers, and 54 private men: there are, besides, the colonel, one lieutenant-colonel, one major, an adjutant, a regimental surgeon and assistant, and a veterinary surgeon. See *HOSE-GUARDS*.

The establishment of a royal regiment of artillery took place early in the last century; the first commission of colonel having been issued, as it is said, in the first year of the reign of George II. In a short time, the number of companies was augmented from four to eight. The uniform was blue, turned up with red; and waistcoats and breeches of the colour of the facings were then worn by the officers. The artillery take the right of foot on all parades, and likewise of dragoons, when dismounted. Each battalion consists of one colonel commandant, one ditto en-second, one first lieutenant-colonel, two second lieutenant-colonels, one major, ten captains, ten captain-lieutenants, thirty lieutenants, one adjutant, one quarter-master, one surgeon, and one assistant surgeon. The establishment of each company is 120 rank and file. The standard height of the men is 5 feet 9 inches, and upwards. The uniform of the officers is blue, faced with scarlet, gold epaulets, no lace, white waistcoat and breeches, boots, yellow breastplate on a white buff shoulder-belt. The uniform of the privates is blue, with red cuffs and collar, no facings, yellow lace, and buttons impressed with the ordnance arms. The serjeants wear frogged gold lace. The arms of the officers and serjeants are yellow-hilted swords; of the corporals, bombardiers, and privates, carbine and bayonet. The horse artillery have swords and pistols. The officers rise in a regular gradation by seniority. See *ARTILLERY*.

The first or royal regiment of foot claims a high degree of antiquity. It is undoubtedly the oldest regiment in the service. It is said to have been the body-guard of the Scottish kings, whence it has derived its name of the royal Scots, and to have been put upon the English establishment in 1633. The first colonel was nominated during the reign of Charles I.; but on the fatal issue of the civil wars to that monarch, this corps seems to have been disbanded. At the restoration of Charles II., this regiment was re-established. It consists of two battalions, both commanded by the same colonel: in every other respect they are considered as separate corps. The uniform of the officers is scarlet, faced with blue, gold lace embroidered; that of the private soldiers red, faced with blue and white lace.

The second, or queen's royal regiment of foot, was raised in the year 1661. The regiment being royal, the facings for the whole are blue; the lace for the privates white, with a blue stripe.

The third regiment of foot, called the "Buffs," was put upon the regular establishment of the army in the year 1665. It was denominated the "Buffs," from being the first whose accoutrements were made of leather prepared from the buffalo, after the manner of shamois. The waistcoats, breeches,

and facings of the coat, were afterwards directed to be made of a corresponding colour. When other regiments assumed this part of their appointment, the third acquired the name of the "Old Buffs." This regiment has the exclusive privilege of marching through the city of London by beat of drum. Its uniform is red, with buff facings; buff waistcoats and breeches. The 31st regiment, which has the same uniform, is commonly called the "Young Buffs."

The fourth, or king's own regiment of foot, was raised in the year 1680, by Thomas earl of Plymouth. This regiment was the first that joined king William, on his landing at Torbay; on which occasion his majesty honoured it with the title of the king's own regiment; and directed it to bear in its colours the lion of England, which still continues the badge of the regiment, and is worn on the breast-plate, buttons, cap, and pouch. The uniform of the regiment, at the beginning of the last century, was red, faced with blue velvet, and large velvet cuffs, richly embroidered with gold. The present uniform is red, with plain blue facings, silver buttons and epaulet, white waistcoat and breeches. On the epaulet, buttons, and breast-plate, are the crown and garter, and round the latter "The King's own Infantry." In the centre is the lion of England, and under it the number iv in small Roman figures.

The fifth regiment of foot was raised by James II.; but it followed the fortunes of the prince of Orange. When the 4th, 5th, and 6th regiments were first raised, they were not placed upon the British establishment, but sent by James II. for the service of the states-general. On the abdication of that monarch, and the subsequent election of William, prince of Orange, they were numbered and taken into the line, according to the periods at which they landed from Holland. Thus the 4th, which had originally been raised after the 5th, arrived in England before it, and took precedence. The 6th, which had been levied before the 5th, returned at a later period than either, and was consequently placed according to that date. The 5th regiment has been augmented to two battalions, by drafts from the militia; its uniform glistening green facings. The 24th, 54th, and 69th regiments are also faced with light green.

The sixth regiment of foot derives its origin from the seven years' war, in the course of which the United Provinces of Holland threw off their subjection to Spain. Its regular establishment did not take place until the year 1673; but it had previously served under the three first princes of Orange. This was one of the three regiments intended, on their formation, to serve in Holland; and, therefore, it was paid by the Dutch republic. It came over to this country with king William, at the revolution in 1688, and was incorporated in our military establishment, being numbered as the 6th in the British line. Its uniform is deep yellow facings, white lace, with yellow and red stripes. The 9th, 10th, 12th, 13th, 15th, 16th, 20th, 25th, 26th, 28th, 29th, 30th, 34th, 35th, 37th, 38th, 44th, 46th, 57th, 62d, and 67th regiments have also yellow facings and white lace; and are distinguished from each other by the variations of the stripes, the tinge of the colour, &c.

The seventh regiment of foot, or "Royal Fusileers," was raised, with nine others of infantry, and eight of cavalry, under James II., in the year 1685, three years before his abdication. As a fusileer regiment, the men wear caps, similar to those of the grenadiers, but somewhat shorter. In all other respects they are dressed and appointed as the soldiers of other battalions. Three years after this, another regiment was raised, under the denomination of "Royal Welsh Fusileers." This partiality for cap regiments is said to have been caused by the celebrity of the British grena-

diers, who were easily distinguished by their caps. (By a regulation in 1800, all the regiments of the line, as well as the guards, are to wear a kind of caps.) The officers in these regiments never carried spontoons, as the others did till the late change, but had fusils, like the officers of the flank companies throughout the army. The other regiments of fusileers have second lieutenants, instead of ensigns. This regiment is peculiar in having none but first lieutenants, under the field-officers and captains. The uniform is royal blue facings, with white lace, and a blue stripe. The 8th, 18th, 21st, 23d, 42d, and 60th regiments have also blue or royal facings, but different lace.

The first, or king's regiment of dragoon-guards, was raised and entered on the establishment on the 6th of June 1685. The establishment of this regiment, called, during its services in Germany in the course of the seven years' war, "Bland's dragoons," from the name of the officer who was then at the head of it, is ten troops, each consisting of one captain, one lieutenant, one cornet, one quarter-master, four serjeants, four corporals, one trumpeter, and seventy-one rank and file. The average height of the men is 5 feet 10 inches; of the horses, 15 hands $1\frac{1}{2}$ inch. The uniform of the officers is scarlet and gold lace, blue cuffs and collar; no facings on the ordinary uniform. The uniform of the troopers, red jacket, faced half-lappel, blue, white lace, buttons marked K. D. G. The serjeants wear gold lace. The second, or queen's dragoon-guards, is one of the eight cavalry regiments raised in 1685, the second year after the accession of king James II. to the throne. Five of these remain on the English establishment, and three on the Irish: of the former five, three are distinguished as "Dragoon-guards," the other two as "Dragoons;" the first of which is denominated "the king's own regiment." The uniform of the officers red, faced with black velvet and silver lace; and that of the troopers red jacket, black collar and cuffs, royal lace, white buttons, marked Q. D. G. The serjeants wear silver lace. The third, or prince of Wales's dragoon-guards, is the last of the three regiments distinguished as dragoon-guards upon the British establishment. The uniform is scarlet, faced with white, and yellow buttons. The fourth, or royal Irish regiment of dragoon-guards, was raised, with seven others of the cavalry, in the year 1685, soon after James II. ascended the throne. It was originally called "the Prince of Wales's," or first regiment of horse; and, with the other three of horse upon the same establishment, it was, in the year 1788, put upon a new one, and called "Dragoon-guards," numbering on to seven; so that the fourth of horse, formerly so called, is now the seventh dragoon-guards. The uniform is royal, with silver lace. The fifth regiment of dragoon-guards, commonly called the "Green Horse," was originally the second of horse, and raised in England in the reign of king James II., in the month of July 1685. It was at that time put upon the regular British establishment. It went over with king William to Ireland in 1689, and remained more than 100 years upon the Irish establishment. It is now on the English establishment; and consists of nine troops, of the same strength with those of the fourth regiment of dragoon-guards; each troop consisting of one quarter-master, four serjeants, four corporals, one trumpeter, and seventy-one privates. The uniform of the regiment is green facings with gold lace for the officers, and yellow for the private men. The height of these men is in general from 5 feet 8 inches to 6 feet. The first, or royal regiment of dragoons, was raised for the service of Charles II. in 1683. Their badge is a horse-shoe, inclosing 1st D., encircled with a wreath of laurels; the regiment consists of nine troops, of the usual number. The colour of the horses is black. The

second, or royal North British dragoons, called the "Scots Greys," were raised in Scotland during the reign of James II. The uniform is red, with gold lace, no facings, but blue collar and cuffs. The horses are of an iron-grey colour, except those of the officers and trumpeters, which are of a light grey, approaching to white. The fifth, or royal Irish regiment of dragoons, was raised in or about the year 1688. In consequence of the good behaviour of this regiment at the battle of Hochstet, in August 1704, three additional troops were put upon the establishment, making its strength to consist of nine troops. Again this regiment, assisted by the Scots greys, distinguished itself at the battle of Ramillies in 1706; and both corps were distinguished from other cavalry regiments, by being permitted to wear grenadier caps. The permanency of the nine troops was secured by an order, dated in 1798. At this time there was an insurrection of the rebels in the disaffected parts of Ireland, and this regiment was ordered to resist and suppress it. In order to supply the loss it sustained in several conflicts with the rebels, its officers were instructed to receive eligible recruits. Many were enlisted, who, as the event afterwards proved, were rebel-partisans, who entered into a desperate plot for seizing the garrison at Lehaunstoun and massacring every officer and loyal soldier. The conspirators were seized, and suffered according to their deserts. The regiment, however, had the mortification to find it announced in the public papers, that several privates belonging to the fifth or royal Irish dragoons, had been found guilty by a general court-martial of joining the rebels. In consequence of this the regiment was, on the 10th of April following, disbanded by an order from his majesty, dated April 8th, 1799. See *Grofe's Mil. Ant.* vol. ii. appendix.

REGIMENTAL *Court-martial.* See **COURT-MARTIAL.**

REGIMENTAL *Staff.* See **STAFF.**

REGIMENTALS, the uniform clothing of the army, consisting of a hat, coat, waistcoat, breeches, shirts, stocks, shoes, stockings, spats, spatterdashies, &c.

REGINA, in *Geography*, a town of Naples, in Calabria Citra; 12 miles N. of Cosenza.

REGINA *Aurarum*, in *Ornithology*, a name given by Nie-remberg to a bird called by the Mexicans *cozacoaubtli*. It has obtained its name from its being able to fly against the strongest winds. It is of the bigness of an eagle, and its whole body is of a blackish purple, variegated with a brownish-yellow and deep black; its wings are variegated with black, yellow, and grey; its legs are red; its claws very strong and sharp; and its beak like that of a parrot; it has some rugose skin on the forehead, and about the beak; and its tail is black above, and grey underneath. It feeds on snakes, rats, and other vermin, but will also eat human dung; it flies very high; it is a native of Mexico, and breeds in spring; its feathers are said to be a remedy for many diseases; but the truth of this account is much to be doubted. Ray.

REGINA, *Salve.* See **SALVE.**

REGINELLI, **NICOLA**, in *Biography*, an Italian opera singer, renowned for his knowledge and the purity of his taste. He arrived in London in the autumn of 1746, an old but great singer, whose voice as well as person were in ruin. He first appeared on our stage in a pasticcio, called "Annibale in Capua." This performer was now turned of fifty; his voice a *soprano*, but cracked, and in total decay; his figure tall, raw-boned, and gawky; but there were fine remains of an excellent school in his taste and manner of singing; indeed, he had some refinements in his embellishments and expression, that cannot be described, and which we have not since heard in any other singer. In a *cantabile*, his taste, to

those who had places near enough to hear his *riffaramenti*, was exquisite; but the imperfections of his voice and figure disgusted those at a distance, to whose ears only the word part of his performance arrived.

REGINO, a celebrated German ecclesiastical writer and chronicler, who flourished in the ninth and tenth centuries. He embraced the monastic life at the Benedictine abbey of Prüm, in the diocese of Treves, and by his conduct gained such general respect among the fraternity, that in the year 892 he was made abbot, which office, however, from the jealousy of his rivals, he was obliged to resign in 899. After this he probably retired and spent the remainder of his days in the abbey of St. Maximin at Treves. He died about the year 908. He was author of "A Chronicon," extending from the birth of Christ to the year 907, which is said to be very useful in illustrating the history of his time, and particularly that of the Franks and Germans. This chronicon was published at Frankfort in 1583, with an appendix by another hand, continuing it from the year 907 to 972, and it is to be found in Pistorius's collection, entitled, "Scriptores de Rebus Germanicis." Regino was author likewise of "De Disciplinis Ecclesiasticis et Religione Christiana," in two books, of which the first contains those canons which relate to ecclesiastical persons, and the second, those which regard the laity. This work was undertaken by him about the year 906, at the desire of the archbishop of Treves, for the special benefit of his diocese. It was first published, with an appendix, by Joachim Hildebrand, at Helmstadt, in 1659, from a manuscript of Flacius Illyricus; and afterwards by M. Baluse, with additions, and a learned preface and notes, in 1671. Trithemius pronounces Regino to have been the best German writer of his age.

REGINO, in *Geography*, a town of Golo, or the island of Corsica, in the department of Calvi; the canton of which contains 3913 inhabitants.

REGIO *Assensu*, in *Law*, is a writ by which the king gives his royal assent to the election of a bishop.

REGIOMONTANUS, in *Biography*. See **MULLER.**

REGION, in *Anatomy*, denotes a division of the human body. Some anatomists have divided the body into three regions, or venters.

The upper region is that of the head, reaching as low as the first vertebra, and comprehending the animal organs, the brain, &c. See **HEAD**, &c.

The middle region is that of the thorax or breast, which Hippocrates calls the upper venter, and which reaches from the clavicles to the diaphragm: in this are contained the vital parts, as the heart, lungs, &c. See **HEART**, **LUNGS**, &c.

The third, or lower region, is the abdomen or belly, &c. containing the natural parts, destined for digestion, purgation, and generation. See **ABDOMEN**.

REGION, *epicolic*, *epigastric*, and *umbilical*. See the adjectives.

REGION, *Regio*, in *Geography*, a country, or particular division of the earth; or a tract of land inhabited by people of the same nation.

The modern astrologers divide the moon into several regions, or provinces, to each of which they give its proper name. See **MOON**.

REGION, in *Physiology*. Authors divide the atmosphere into three stages, called the *upper*, *middle*, and *lower* regions. See **ATMOSPHERE**.

The lowest region is that in which we breathe, and is bounded by the reflexion of the sun's rays, that is, by the height to which they rebound from the earth.

The middle region is that in which the clouds reside, where

meteors are formed, &c. extending from the extremity of the lowell to the tops of the highest mountains.

The upper region commences from the tops of the mountains, and reaches to the utmost limits of the atmosphere. In this reigns a perpetual, equable calmness, clearness, and serenity.

REGION, *Elementary*. See ELEMENTARY.

REGION, *Ethereal*, is used for the whole extent of the universe, including the orb of the fixed stars, &c.

REGIONS *of the Sea*. As some naturalists, in their descriptions of the subterraneous parts of the globe, distinguish the earth into three regions of different depths, in which different temperatures are observed; so in describing the sea, they allow it two regions; the one extending from the surface of the water, down so low as the rays of the sun can pierce, and extend their influence; and the other, from the lowest bounds of that to the bottom. It is easy to see that these regions rather regard quality than space, and that their boundaries are far from being regular, or equal in all places, and at all times. The places exposed to the hottest sunshine will have the largest upper region; those where the sun has least power will have the smallest; and the same part of the sea will have its upper region more or less deep, according to the season of the year. This upper region of the sea is always more or less hot; the lower region, except in some few particular places, is every where cold; and the water, where the upper region is large, is always remarkably still and quiet in the lower. Boyle of *Cosmical Qualities*.

REGION, *Subterranean*. The earth is not only divided on its surface into regions and countries, but philosophers, who have had occasion to discourse of its inner parts, have also divided them into three distinct regions, according to their different depths from the surface. The temperature of the subterranean parts of the globe is distinguished according to the division of these regions, but is not so regular and precise as some have supposed. The first region of the earth is very variable, both as to bounds and temperature. The second region seems for the most part cold, in comparison of the other two; but in several places, which, by reason of their distance from the surface of the earth, it would be natural to call the middle region, the temperature of the air is very different at the same seasons of the year, which shews that it depends on something more than bare depth from the surface. The third region of the earth is universally observed to be warm, but by no means regularly or uniformly: the same depth in some places, giving only a moderate warmth, while in others it gives a very considerable heat.

Borrichius tells us of a certain abbé, fond of chemistry, and particularly curious in the matter of long digestions by regular heat, who found a way of making a furnace perpetually warm, by piercing the earth to a certain depth, and using the heat of this third region of it. His method, we are told, was to bore a hole with a pike twenty feet deep, and pour into it ten or twelve pounds of quicksilver; this made its way into the strata, and through them in a body into the chambers of heat in this third region, where the heat, having a vent upwards, made by this opening, never failed to ascend in a perpetual and regular stream, and gave that regular and digesting heat that no artificial fire could equal. But this is an alchemical story. Boyle of *Cosmical Qualities*. Borrich. de *Ortu Chem.*

REGION, in ancient Rome, a part or division of the city. Romulus divided his little city into three tribes, and Servius Tullius added a fourth; which division continued till Augustus's time, who first divided the city into fourteen regions, over each of which he settled two surveyors, called *curatores viarum*, who were made annually, and took their

divisions by lot. These fourteen regions contained 424 streets, 31 of which were called great or royal streets, which began at the gilt pillar that stood at the entry into the open place in the middle of the city.

The extent of these divisions varied greatly, some being from 12,000 or 13,000 to 33,000 feet and upwards in circumference. Authors, however, are not agreed as to the exact limits of each.

According to Kennet, who formed his division on the authority of the accurate Panvinus, the different regions were as follow: The *first* region, called "Porta Capena," contained 9 streets, 3 luci, or consecrated groves, 4 temples, 6 ædes, or sacred buildings, 6 public baths, 4 arches, 14 granaries, 12 mills for grinding corn, and 121 domi, or great houses. The whole compass of this region, or ward, was 13,223 feet. The *second* region, denominated "Cæli-montium," included 12 streets, 2 luci, 5 temples, the public baths of the city, 80 private baths, the great shambles, 23 granaries, 23 mills, and 133 great houses. Its compass was 13,200 feet. The *third* region, or Isis and Serapis, contained 8 streets, 2 temples, the amphitheatre of Vespasian, the baths of Titus, Trajan, and Philip, 19, or, as some say, 29 granaries, 23 mills, 160 great houses. Its compass was 12,450 feet. The *fourth* region, Via Sacra, or Templum Pacis, comprehended 8 streets, 10 temples, the colossus of the sun, 120 feet high, the arches of Titus, Severus, and Constantine, 75 private baths, 18 granaries, 24 mills, and 138 great houses. Its compass, according to some, was only 8000, but, according to others, 14,000 feet. The *fifth* region, or Esquilina, included 15 streets, 8 luci, 6 temples, 5 ædes, 75 public baths, 18 granaries, 22 mills, and 180 great houses. Its compass was 15,950 feet. The *sixth* region, Aëta Semita, contained 12 or 13 streets, 15 temples, 2 porticos, 2 circi, 2 fora, 75 private baths, 19 granaries, 23 mills, 155 great houses. Its compass was 15,600 feet. The *seventh* region, Via lata, included 40 streets, 4 temples, 75 private baths, 3 arches, 17 mills, 25 granaries, and 120 great houses. Its compass was 23,700 feet. The *eighth* region, Forum Romanum, included 12 streets, 21 temples, 66 private baths, 10 ædes, 9 porticos, 4 arches, 7 fora, 4 curiæ, 7 basilicæ, 6 columns, 18 granaries, 30 mills, and 150 great houses. Its compass was 14,876 feet. The *ninth* region, Circus Flaminius, comprehended 20 streets, 8 temples, 20 ædes, 12 porticos, 2 circi, 4 theatres, 3 basilicæ, 2 curiæ, 5 baths, 2 arches, 2 columns, 32 mills, 32 granaries, and 189 great houses. Its compass was 30,560 feet. The *tenth* region, Palatium, contained 7 streets, 10 temples, 9 ædes, 1 theatre, 4 curiæ, 15 private baths, 12 mills, 16 granaries, and 109 great houses. Its compass was 11,600 feet. The *eleventh* region, Circus Maximus, included 8 streets, 22 ædes, 15 private baths, 16 granaries, 12 mills, and 189 great houses. Its compass was 11,600 feet. The *twelfth* region, Piscina Publica, contained 12 streets, 2 ædes, 68 private baths, 28 granaries, 25 mills, and 128 great houses. Its compass was 12,000 feet. The *thirteenth* region, or Aventinus, included 17 streets, 6 luci, 6 temples, 74 private baths, 36 granaries, 30 mills, and 155 great houses. Its compass was 16,300 feet. The *fourteenth* region, Transiberina, contained 23 streets, 6 ædes, 136 private baths, 20 granaries, 32 mills, and 150 great houses. Its compass was 33,409 feet.

REGIONARY, REGIONARIUS, in *Ecclesiastical History*, a title given, from the fifth century, to persons who had the charge and administration of the church affairs within a certain district or region.

At Rome there were anciently seven regionary deacons, who

who presided over a kind of hospitals, and looked to the distribution of alms.

There were also regionary subdeacons, and regionary notaries, as also regionary bishops, &c.

A regionary bishop was properly a missionary invested with an episcopal character, but without being attached to any particular see, that he might be at liberty to go to preach, and perform other functions of his ministry, whithersoever the Spirit of God and the wants of the people should call him.

REGIS, PETER-SYLVAN, in *Biography*, a celebrated French philosopher, was born at Salvétat de Blanquefort, in the Agenois, in the year 1632. After having been instructed in classical learning and the belles lettres, by the Jesuits, at Cahors, he entered himself a student of divinity at the university of that city, intending to qualify himself for the clerical profession. This, however, he abandoned, in order to devote himself to the study of the Cartesian philosophy, which at that time was taught with great success by Rohault. With this view he went to Toulouse in 1665, and read a course of lectures upon the principles of Descartes, and was attended by persons of all ranks and characters, who insisted themselves in the number of his disciples. Among these were to be found the magistrates, clergy, and even the women of Toulouse, who affected to be the zealous converts to the new philosophy, in opposition to the old. To express their gratitude to the man who had been the instrument of diffusing this light over their city, the inhabitants granted him a pension; a circumstance which, it has been observed, corresponded more with the spirit and usages of ancient Greece, than of modern times. In 1680 he came to Paris, considering that as the most proper scene for the exhibition of his talents. Here he was extremely popular, and the friends to the Aristotelian system began to be alarmed at his success, and complained against him to the archbishop of Paris, who prohibited him from continuing his lectures, and they were accordingly suspended. But after a short time, the prelate withdrew his interdict, and Regis devoted the remainder of his life to the propagation of the Cartesian philosophy, as well by his writings as his lectures. In 1699 he was admitted a member of the Academy of Sciences, but his infirmities prevented him from attending its meetings. He died in the year 1707, at the age of 75, highly esteemed by persons of the first distinction for talents and rank. He was author of a great number of works, of which the following may be mentioned: "A System of Philosophy, containing Logic, Metaphysics, and Morals;" "An Answer to the Book of M. Huet, entitled 'Censura Philosophiæ Cartesianæ,'" which is mentioned by Bayle as a model for every writer on the same side of the question; "An Answer to the Critical Reflections of Du Hamel on the System of Philosophy."

REGIS, in *Geography*, a town of Saxony, in the bishopric of Nuremberg; 14 miles S. of Leipzig.

REGIS, *St.*, a village of Upper Canada, on the St. Lawrence, half a mile N. from the N. line of the United States. It is seated on a beautiful elevated plain, in the angle between the mouth of St. Regis river and the St. Lawrence. It consists of about 80 houses of hewn logs, inhabited by about 100 Indian families, of the Caghnowaya tribe, who have lived here more than half a century. They are peaceable, honest, and industrious. Their diversions are foot-races, playing at ball, and dancing. They are Roman Catholics, and have a handsome stone church, with a spire, and generally a minister. These Indians have 30,000 acres of land reserved to them S. of the village. They keep a great number of horses and cattle, and raise plenty of corn

on the fertile islands in St. Lawrence. From St. Regis there is a good road to Plattsburg, on Champlain; the distance being 72 miles.—Also, a river of Canada, which rises from lakes near Racket river, and enters the St. Lawrence at the village above-mentioned.

REGIS *Pondus*. See PONDUS.

REGIS *Villa*. See VILLA.

REGISTAN, or *Sandy Desert of Agimere*, in *Geography*, a sandy desert, forming the western boundary of Hindoostan, between the country of Agimere and the Indus. The northern extreme of this desert bounds the dominions of the Seiks on the south.

REGISTER, REGISTRUM, a public book serving to enter and record memoirs, acts, and minutes, to be had recourse to occasionally, for the justifying of matters of fact.

Menage derives the word, by corruption, from *regestum*, a book containing extracts of several books, &c. collected together: "Dicitur regestum quasi iterum gestum." Others derive it from the old French *gister*, to lie down in a bed, &c.

The law of Scotland is rendered very easy and regular, by means of the great number of registers, for recording the conveyances of lands, &c. of private persons. Of these there are two kinds: the one general, fixed at Edinburgh, under the direction of the lord register, who, before the Union, was the fifth officer of the state, and, besides the registry, was clerk of the parliament, treasury, exchequer, and session.

The other is particularly kept in the several shires, stewarts, and regalties. The clerks of it are obliged to transmit the registers of their respective courts to the general register; and the notaries their protocols: and here they are so disposed, that, on demand, the lieges can have a view of any writs which the law requires to be registered, or which parties, for their security, have thought fit to record.

The registers were first set on foot by act of parliament, under king James VI., to the unspeakable advantage of the subject.

No man can have a right to any estate, but it must be registered within forty days of his becoming seized of it, otherwise it is null; and by this means all secret conveyances are cut off.

By a law in 1704, it was enacted, that a memorial of all deeds and conveyances, and of all wills and devises in writing, by which any honours, manors, &c. in the West Riding of Yorkshire, might be any way affected in law or equity, may, at the election of the party or parties concerned, be registered: and that, after such register, every subsequent deed or conveyance of the said honours, manors, &c. so registered, or any part of it, shall be adjudged fraudulent and void, unless a memorial of it shall be also registered: and the like of wills, &c. But this act did not extend to copyhold estates, nor to leases at rack-rent, nor to any lease not exceeding twenty-one years.

In the year 1708, a similar statute was passed for the registering of deeds, conveyances, wills, devises, mortgages, &c. in the East Riding of Yorkshire: and all the provisions and clauses in this act were hereby extended to the honours, manors, lands, and tenements, in the West Riding of the same county.

In 1709, a law was made for the public registering of deeds, conveyances, wills, &c. in the county of Middlesex; which may be done for the fee of one shilling: and every deed or conveyance, which shall hereafter be executed, shall be adjudged fraudulent and void, against any subsequent purchaser or mortgagee for valuable consideration, unless such memorial of it be registered according to the direction of

of this act, before the registering of the memorial of the deed or conveyance, under which such subsequent purchaser or mortgagee shall claim; and the like as to memorials of wills not registered.

In 1735, a similar register of mortgages, &c. was legally enacted for the North Riding of the county of York; whence York and Middlesex are register counties. (2 & 3 Ann. cap. 4. 6 Ann. cap. 35. 7 Ann. cap. 20. 3 Geo. II. cap. 6.) These statutes do not extend to copyhold estates, leases at a rack-rent, or to any leases not exceeding 21 years, where the possession goes with the lease; nor to any chambers in the inns of court.

Many have wished that the same regulation was extended to all the counties of England and Wales; but judge Blackstone observes, that, however plausible these provisions may appear in theory, it hath been doubted, by very competent judges, whether more disputes have not arisen in those counties, by the inattention and omission of parties, than prevented by the use of registers.

REGISTER, more correctly *Registrer*, *Registrarius*, is also used for the clerk, or keeper of a register, or registry.

Of these we have several, denominated from the registers they keep; as register of the high court of delegates, registers of the arches court of Canterbury, register of the court of admiralty, register of the prerogative court, registers of the province of Canterbury, register of the archdeaconry of Middlesex, &c. register of the faculty office, and register of the garter, who is always dean of Windsor, and deputy registers.

There are also, in the court of chancery, the principal register, the lord chancellor's registers, the registers of the master of the rolls, entering registers, and register of the affidavits.

The appellation of register or registrarius is also given to a notary. See NOTARY, and NOTARY, *Public*.

REGISTER, *City*. See TOWN-CLERK.

REGISTER of a parish church, is a book in which the yearly baptisms, marriages, and burials, of each parish, are orderly registered. See MARRIAGE.

This practice was laudably instituted by that great but unfortunate person Thomas Cromwell, earl of Essex, anno 1538, while he was vicar-general to king Henry VIII.; and it was continued in the reigns of king Edward VI. and of queen Elizabeth.

These parish registers are to be kept in a coffer, provided by the churchwardens, with three locks and keys, one of which is to remain with the minister, and the other two with the churchwardens severally, so that neither the minister without the two churchwardens, nor the churchwardens without the minister, shall at any time take that book out of the said coffer. These parish registers are to be subscribed by the minister and churchwardens; and the names of the persons shall be transmitted yearly to the bishop; and it has been enforced by canon 70, and by statute, &c.

By 26 Geo. II. c. 33. to make a false entry in a marriage register, to alter it when made, to forge or counterfeit such entry or a marriage licence, or aid and abet such forgery, to utter the same as true knowing it to be counterfeit, or to destroy or procure the destruction of any register, in order to vacate any marriage, or subject any person to the penalties of this act; all these offences, knowingly and wilfully committed, subject the party to the guilt of felony, without benefit of clergy.

By the 30 C. II. c. 5. for burying in woollen, it is enacted, that the minister of every parish shall keep a register in a book to be provided at the charge of the parish,

and make a true entry of all burials within his parish, and of all affidavits of persons being buried in woollen brought unto him according to the said act; and where no such affidavit shall be brought to him within the time therein limited, he shall enter a memorial thereof in the said registry, against the name of the party interred, and of the time when he notified the same to the churchwardens or overseers of the poor according to the said act.

An approved register of births, consisting of certificates signed by two persons who were present at the said births, and entered in a book signed by the register or secretary, is kept with great accuracy, and authenticated by a committee, for the benefit of Protestant dissenters and others. This book is deposited and carefully preserved at Dr. Williams's library, Red-cross Street, Cripplegate, to which any person may have free access at the stated hours, under the direction of the secretary of the said library, whose attention to his office entitles him to public respect.

REGISTER is also a title of a book, containing the forms of most of the writs, original and judicial, used in common law. This is called the *register of writs*, or *register omnium brevium*. This register, Coke on Littleton observes, is one of the most ancient books of the common law. And judge Blackstone observes concerning it, that it is the most ancient and highly venerable collection of legal forms, upon which Fitzherbert's *Natura Brevium* is a comment, and in which every man, who is injured, will be sure to find a method of relief, exactly adapted to his own case, described in the compals of a few lines, and yet without the omission of any material circumstance.

REGISTER, in *Antiquity*, a book or table at Athens, belonging to each particular *φρῆσις*, or ward, in which all fathers were obliged to enrol their sons, making oath, at the same time, that every son, so registered, was either born to them in lawful wedlock, or lawfully adopted. The adopted sons were registered in the festival Thargelia; the natural, upon the third day of the festival Apaturia.

At what age children were thus registered is not agreed. Some are of opinion, that at every return of the Apaturia it was customary to register all the children that had been born that year. Others affirm, that they were commonly three or four years old before they were registered.

There were two other seasons when young Athenians were enrolled in a public register: one, when they arrived at the age of eighteen years, and were admitted into the number of the *ἐφηβοί*, and was performed on the third day of the festival Apaturia; and the other, before the festival Panathenæa, when those who were twenty years old were entered in a register, called *λῆξις καὶ γαρμμάτιον*, in which the names of all persons of that borough, who were of age to succeed in the *λῆξις*, or inheritance of their fathers, were entered. This was termed *to be registered among the men*; and the persons, thus enrolled, became their own masters, and free from the government of their guardians. Potter's *Arch. Græc.* vol. i. p. 48.

REGISTERS of *Estates*, the accounts of particular things which belong to them, as those of rentals, valuations of fields, names, admeasurements, different portions of land, cottages, and other buildings distinct from the farms, and any other separate parts. In these registers the valuations are to be inserted in columns, as they arise from surveys or other ways, and afford the means of fixing the real values in re-letting the lands or for other purposes.

Also, a general register of the *timber trees* which are growing on the several divisions of the estates, should always be kept; in which the number contained in each separate wood, grove, hedge-row, or any other part, must be entered,

tered, with their kinds, and the admeasurement of each, for the use of the proprietor and wood managers.

A great many other forts of particulars regarding the estates may likewise be usefully and conveniently put down in these registers.

REGISTER of *Seamen*. See *MANNING the Fleet*.

REGISTER *Ships*, or *Ships of Register*, in *Commerce*, were vessels to which the king of Spain, or the council of the Indies, granted permission to go and traffic in the ports of Spanish America.

They were thus called, because the ships were to be registered before they set sail from Cadiz, which was the place where they usually loaded for Buenos Ayres.

These vessels, by the tenor of the cedula or permit, were not to exceed three hundred tons; but there subsisted that good understanding between the merchants and the council of the Indies, that ships of five or six hundred tons frequently passed unnoticed.

These register ships, which were first introduced in order to furnish America with a regular and timely supply, and thus to prevent a contraband trade with the English, French, and Dutch islands, were fitted out, during the intervals between the stated seasons, when the galleons and flota sailed, by merchants in Seville or Cadiz, upon obtaining a licence from the council of the Indies, for which they paid a very high premium, and were destined for those ports where any extraordinary demand was foreseen or expected. In proportion as experience manifested the advantages of carrying on trade in this mode, the number of register ships increased, and at length, in the year 1748, the galleons, after having been employed upwards of two centuries, were finally laid aside. From that period there has been no intercourse with Chili and Peru, but by single ships dispatched from time to time, as occasion requires, and when the merchants expect a market will open. These sail round Cape Horn, and convey directly to the ports in the South sea the productions and manufactures of Europe, for which the people settled in those countries were formerly obliged to repair to Porto Bello or Panama.

But as all the register ships destined for the South seas were obliged to take their departure from Cadiz, and were under a necessity of returning thither, this branch of the American commerce, even in its new and improved form, continued subject to the restraints of a species of monopoly, and felt its pernicious effects.

The intercourse between Spain and her colonies has in later times been much improved and facilitated. In the year 1764, Charles III. appointed packet-boats to be dispatched on the first day of each month from Corunna to the Havanna or Porto Rico. From thence letters are conveyed in smaller vessels to Vera Cruz and Porto Bello, and transmitted by post through the kingdom of Tierra Firmé, Granada, Peru, and New Spain. Packet-boats also sail with the same regularity, once in two months, to Rio de la Plata, for the accommodation of the provinces to the east of the Andes.

With this new arrangement for facilitating intercourse a scheme of extending commerce has been more immediately connected. Each of the packet-boats, which are vessels of some considerable burden, is allowed to take in a loading of such commodities as are the product of Spain, and most in demand in the ports whither they are bound. In return for these, they may bring home to Corunna an equal quantity of American productions. This regulation may be considered as the first relaxation of those rigid laws, which confined the trade with the new world to a single port, and the first attempt to admit the rest of the kingdom to

some share in it. This measure of relaxation was soon followed by another more decisive. In the year 1765, Charles III. laid open the trade to the windward islands, Cuba, Hispaniola, Porto Rico, Margarita, and Trinidad, to his subjects in every province of Spain. This ample privilege was soon after extended to Louisiana, and to the provinces of Yucatan and Campeachy. As soon as this general liberty was permitted, it produced the most beneficial effects: and it has been computed, that such a number of ships was soon employed in the free trade, that the tonnage of them far exceeded that of the galleons and flota, at the most flourishing era of their commerce. This arrangement extended its good effects through every province of the kingdom; and by opening a new market for their various productions and manufactures, encouraged and added avidity to the industry of the farmer and artificer. Spain has also permitted a free trade between the colonies themselves. In the year 1774 Charles III. published an edict, granting to Peru, New Spain, Guatimala, and Granada, the privilege of a free trade with each other. See *Robertson's Hist. of America*, vol. iii.

REGISTER, among *Letter Founders*, is one of the inner parts of the mould in which the printing types are cast. Its use is to direct the joining of them justly together again, after opening them to take out the new-cast letter.

REGISTER, in *Printing*, the disposing of the forms of the prefs, so as that the lines and pages printed on one side of the sheet meet exactly against those on the other; which is done by means of two points in the greater or outward tympan.

REGISTER, in *Organ-building*, is another word for a stop in that instrument; but is in fact only a lath pierced with holes, corresponding with those in the sound-board, which by drawing out the stops opens the holes, and putting them in shuts them. By these sliders each stop speaks or is silent. Register is figuratively used by musicians in speaking of a voice, in which real and falset notes are not well united. Mr. Braham's *high* notes, for example, are said to be of a different register from the *low*.

REGISTERS, in *Chemistry*, are holes, or chinks, with stopples to them, contrived in the sides of furnaces, to regulate the fire; *i. e.* to make the heat immediately more intense, or remiss, by opening them to let in the air, or keeping them close to exclude it. See *FIRE-places* and *FURNACE*.

REGISTRY, REGISTRUM, comprehends the office, books, and rolls, in which the proceedings of chancery, or any spiritual court, are registered or recorded.

REGISTRY of *Shipping*, in *Commerce*. The registering of ships appears to have been first introduced into this country by the *NAVIGATION Act*, 12 Car. II. c. 18. § 10. By this statute, however, foreign ships only, "British owned," were required to be registered. By stat. 7 & 8 W. III. c. 22. § 17, British or plantation built ships, British owned, if intended to be employed in the plantation trade, and also all "prize ships," were required to be registered; and in consequence of a regulation at the admiralty, ships for which Mediterranean passes were wanted, were also to be registered. The provisions in the acts requiring registry are founded upon the wisest policy, and are not less calculated to prevent the commission of private fraud upon individuals, than to advance the public policy of the state. By stat. 26 Geo. III. c. 60. (lord Hawkebury's act), no ship or vessel foreign built (except such as have been condemned as lawful prize in any court of admiralty), nor any ships or vessels built or rebuilt upon any foreign made keel or bottom, although owned by British subjects, and navigated according

according to law, shall be entitled to the privileges of a British built ship, or of a ship owned by British subjects; and all the privileges and advantages allowed shall be confined to such ships only as are wholly of the built of Great Britain or Ireland, Guernsey, Jersey, and the Isle of Man, or some of the plantations in Asia, Africa, or America, now belonging, or which may hereafter belong to his majesty, except such foreign built vessels as before the 1st of May 1786 did truly and wholly belong to British subjects, navigated according to law, and duly registered, which shall continue to enjoy the privileges to which such ship or vessel is by law entitled; nor shall this act prevent any such vessel which may have been begun to be repaired or rebuilt before the 1st of May 1786 from being registered, provided it shall appear upon oath, to the satisfaction of the commissioners of the customs, that such vessel was stranded by the act of Providence, and was at the time of being so stranded the sole property of some foreigner, or a droit of the admiralty; and if it shall appear that such vessel, from the damage received, was rendered unfit to proceed to sea without undergoing a thorough repair in this kingdom, and that she was necessarily sold for the benefit of the foreign owners, or under an order or commission from the court of admiralty, and that she was fairly and openly purchased by a British subject, and being the sole and entire property of such British subject, that she had been so much repaired, that two-thirds of her at least are of British built, she may be registered. f. 1.

No vessel shall be deemed British built, or enjoy the privileges belonging to British built vessels, which shall be rebuilt or repaired in any foreign port, if such repairs shall exceed 15s. for every ton, unless such repairs shall be rendered necessary by extraordinary damage, and absolutely necessary to enable her to perform the voyage, and to return in safety to some place or port within his majesty's dominions; and before such vessel shall be so repaired, the master shall report her state and condition upon oath to the British consul or other chief officer at the port where such repairs may be necessary, and cause the same to be surveyed by two persons to be approved of by such consul or chief British officer, and shall deliver to such consul or officer, in writing, the particulars of the damage sustained, and verify upon oath the particulars and amount of the repairs, and that the same were become necessary in consequence of damage sustained during her voyage, to enable the same vessel to prosecute her intended voyage, and to return to some port within his majesty's dominions, which must be certified under the hand and seal of the chief consul or other officer; or if no such consul, &c. shall be there resident, the survey shall be made by two persons to be approved of by two known British merchants residing at or near such port. And the master of such ship shall produce to such merchants vouchers of the particulars and amount of the repairs, and their certificate shall be of the same effect as that of the British consul or chief officer. And the masters of vessels repaired in any foreign port shall make oath before the collector and comptroller, or other principal officer of the customs in the first port of arrival (if required so to do), describing the nature and amount of such repairs; and if such expence shall exceed 15s. per ton, and the master or commander of such ship shall neglect or refuse to deliver to such collector or comptroller, or other principal officer of the customs, the certificate by this act required to be produced, such vessels shall to all intents and purposes be deemed foreign built. f. 2.

Ships above 15 tons British owned shall be registered in the manner hereinafter mentioned, and the persons claim-

ing property therein shall cause the same to be registered, and obtain a certificate of such registry from the collector or comptroller of the customs of Great Britain, or the Isle of Man, or from the governor, lieutenant-governor, or commander-in-chief and principal officer of the customs resident in the islands of Guernsey or Jersey, or in any of the said colonies, plantations, or islands respectively.

By § 4, no registry is to be made except in the port to which the vessel belongs.

The port to which any ship or vessel shall hereafter be deemed to belong, shall be the port from or to which the same shall usually trade, or being a new ship, shall intend so to trade, and at or near which the husband or acting owners usually reside.

No American vessel shall be entitled to be registered, or to any of the privileges of a British built ship or vessel, unless such ship shall have been taken and condemned as lawful prize, or having been stranded, shall have been built or rebuilt, and registered in the manner before practised and allowed. f. 7.

No registry shall be made or certificate granted until oath be taken and subscribed before the persons herein before authorized to make such registry and grant such certificate, by the owner of such ship or vessel, if the same belong to one person only; or, in case there shall be two joint-owners, then by both of them, if both be resident within 20 miles of the port where such registry required, or by one of such owners, if one or both be resident at a greater distance; or if the number of such owners shall exceed two, then by the greater number of them, if the greater number shall be resident within 20 miles of such port, not exceeding three of such owners, or by one of such owners, if all shall be resident at a greater distance. f. 9 and 10.

In case the owners shall amount to three or more, and three of such owners shall not personally attend to take and subscribe the oath directed, then such owner or owners as shall attend and take and subscribe the oath, shall further make oath that the part-owner or part-owners absent, is or are not resident within 20 miles, and hath or have not, to his or their knowledge or belief, wilfully absented himself or themselves to avoid taking the said oath, or is or are prevented by illness. f. 11.

By way of identifying the vessel to which a certificate of registry is alleged to be granted, the surveying officer shall go on board such ship or vessel as is to be registered, and strictly admeasure the same in the presence of the master, or any other person appointed for that purpose on the part of the owners, or by the said master, and shall deliver a true account in writing of all such particulars of the built, description, and admeasurement of such ship or vessel as are specified in the certificate, to the person authorized to make such registry; and the said master or such person as shall attend on the part of the owners, is to sign his name to the certificate of such surveying officer, provided such master or other person shall consent and agree to the several particulars set forth in the said certificate. f. 12.

Surveying officers making or granting false certificates to forfeit 100*l.*, and be for ever incapable of holding any office under his majesty. f. 13.

The tonnage of any vessel when afloat is to be ascertained by the following method, *viz.* drop a plumb line over the stern of the ship, and measure the distance between such line and the after part of the stern post at the load water mark; then measure from the top of the said plumb line, in a parallel direction with the water, to a perpendicular point immediately over the load water mark, at the fore part of the main stem: subtracting the above distance from such admeasure-

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admeasurement, the remainder will be the ship's extreme length, from which are to be deducted three inches for every foot of the load draught of water for the rake abaft, and also three-fifths of the ship's breadth for the rake forward; the remainder shall be esteemed the just length of the keel to find the tonnage; and the breadth shall be taken from outside to outside of the plank in the broadest part of the ship, either above or below the main-wales, exclusive of all manner of sheathing or doubling, that may be wrought upon the side of the ship; then multiplying the length of the keel for tonnage by the breadth so taken, and that product by half the breadth, and dividing by 94, the quotient shall be deemed the true contents of the tonnage. Nothing in this act to be construed to alter the manner of admeasuring the tonnage of any ship which has heretofore been practised for the purpose of ascertaining the light duties, or any other duties or imposts payable according to the tonnage of any vessel. f. 14.

At the time of obtaining the certificate of registry, bonds shall be given to his majesty by the master, and such of the owners who shall attend, in the following penalties:

If a decked vessel, or from 15 to 50 tons, 100*l.*; 50 to 100 tons, 300*l.*; 100 to 200 tons, 500*l.*; 200 to 300 tons, 800*l.*; 300 and upwards, 1000*l.*

The condition of every bond given upon registry shall be, that such certificate shall not be sold, lent, or otherwise disposed of to any person or persons whomsoever, and that the same shall be solely used for the service of the ship or vessel for which it was granted; and that in case such vessel shall be taken by the enemy, burned or broken up, or otherwise prevented from returning to the port to which she belongs, the certificate, if preserved, shall be delivered up within one month after the arrival of the master in any port or place in his majesty's dominions, to the collector or comptroller of some port in Great Britain, or the Isle of Man, or of the British plantations, or to the governor, lieutenant-governor, or commander-in-chief for the time being, of the islands of Guernsey or Jersey; and that if any foreigner, or any person or persons for his use and benefit, shall purchase, or otherwise become entitled to the whole or any part or share of, or any interest in such vessel, and the same shall be within the limits of any port in Great Britain, Guernsey, Jersey, Man, or the British colonies, plantations, islands, or territories aforesaid, then in such case the certificate of registry shall, *within seven days after such purchase or transfer of property* in such ship or vessel, be delivered up to the person or persons authorized by this act to make registry and grant certificates thereof at such port and place respectively; and if such ship or vessel shall be in any foreign port when such purchase or transfer shall take place, then that the same shall be delivered up to the British consul or other chief British officer resident at or nearest to such foreign port; or if such vessel shall be at sea, at the time of such transfer of interest and property, then the said certificate of registry shall be delivered up to the British consul or other chief British officer at the foreign port or place in or at which the master or other person having or taking the command of such ship or vessel shall first arrive after such purchase or transfer of property at sea, immediately after his arrival at such foreign port; but if such master above-mentioned in the case above-mentioned shall not arrive at a foreign port, but shall arrive at some port of Great Britain, Guernsey, Jersey, Man, or his majesty's said colonies, plantations, islands, or territories, then the said certificate shall be delivered up in manner above-mentioned, within 14 days after the arrival of such ship or vessel, or of the person who had the command thereof, in any port of Guernsey,

Jersey, Man, or any of his majesty's said colonies, plantations, islands, or territories. And if any pass, called a Mediterranean pass, shall have been obtained and procured by any such ship or vessel, then and in such case the same shall be delivered up at the same time, and in like manner with the certificate of registry, to the persons hereinafter authorized to receive such certificate of registry: and such certificates so delivered up, shall be transmitted forthwith to the commissioners of the customs in England and Scotland respectively; and such Mediterranean passes shall also be transmitted to the admiralty of Great Britain, by the person or persons authorized to receive such certificate and passes, that the same may be cancelled. f. 15.

In case of any alteration of property in the same port by the sale of any share or shares in any ship or vessel after registering thereof, such sale or transfer of property shall always be acknowledged by indorsement in the certificate of registry, before two witnesses, in order to prove that the entire property in such ship is vested in some of the subjects of Great Britain. In case any dispute should arise concerning the same, the above indorsement to be signed by the person transferring the property in such ship or vessel, or by some person legally authorized for that purpose. 7 & 8 W. III. c. 22. f. 21. 34 Geo. III. c. 68. f. 15, and by stat. 26 Geo. III. c. 60. f. 16.

In addition to the above indorsement there shall also be indorsed on the certificate of registry, before two witnesses, the town, place, or parish, where all persons to whom the property in any ship or vessel shall be transferred shall reside; or if such persons usually reside abroad, but in some British factory, then the name of such factory of which such persons are members; or if such persons reside in any foreign town or city, the name of such foreign town or city, and also the names of the house or copartnership in Great Britain or Ireland for or with whom such are agents or partners; and the person to whom the property of such ship or vessel shall be so transferred, or his agent, shall deliver a copy of such indorsement to the person authorized to make the registry, who is to cause an entry to be indorsed on the oath or affidavit upon which the original certificate of registry of such ship or vessel was obtained; and also to make a memorandum in the book of registers, and forthwith give notice to the commissioners of the customs in England or Scotland, under whom they respectively act.

The certificate of registry of such vessel shall be recited in words at length in the bill or instrument of sale thereof, otherwise such bill of sale shall be utterly void. f. 17.

As often as the master or commander of any registered vessel shall be changed, the master or owner thereof shall deliver to the person authorized to make such registry at the port where such change shall take place, the certificate of registry belonging to such ship or vessel, who shall indorse and subscribe a memorandum of such change, and shall give notice to the proper officer of the port where such ship or vessel was last registered; who shall likewise make a memorandum of the same in the register book, and give notice to the commissioners of the customs in England and Scotland. f. 18.

No owner of any ship or vessel shall be permitted to give any other name thereto than that by which she was first registered. And all owners of registered vessels shall, within one month from the registry, paint in white or yellow letters, of a length not less than four inches, upon a black ground, on some conspicuous part of the stern (provided there shall be sufficient space, but if not, then in letters as large as such space will admit), the name by which such ship or vessel shall have been registered, and the port to which

which she belongs, and so keep and preserve the same. And if such owner, or master or commander of such ship or vessel shall wilfully alter, erase, or conceal, or permit the same to be done, unless in the case of square rigged vessels in time of war, or shall in any written or printed paper describe such ship by any other name than that by which she was first registered, or shall verbally describe such ship or vessel by any other name to any officer of the revenue in the due execution of his duty, such owner or commander thereof shall forfeit the sum of 100*l*. s. 19.

By stat. 26 Geo. III. c. 60, all persons who shall apply for a certificate of registry in Great Britain, Guernsey, Jersey, or the Isle of Man, for any ship which shall be built, or whose building shall be completed after the 1st of August 1786, shall produce to the person authorized to grant such certificate a true account under the hand of the builder of the same, of the proper denomination, the time when, and the place where such ship or vessel was built, and an exact account of the tonnage, together with the name of the first purchaser; and also make oath before the person authorized to grant such certificate, that the ship or vessel for which such certificate is required is the same with that so described by the builder. And every person applying for a like certificate in any of his majesty's colonies, plantations, or territories, shall, before such certificate is granted, produce the like account, under the builder's hand, and take the like oath as is required to be produced and taken by persons applying in Great Britain. s. 20, 21.

If any certificate of registry shall have been lost, a register and certificate *de novo*, in the form herein directed, shall be granted for such vessel, according to 15 Geo. II. c. 31; but in all such cases such security shall be given as is directed in this act, and in lieu of the oath prescribed by 15 Geo. II. the like oath shall be taken and subscribed as hereinbefore directed, by the owner or owners of such ships and vessels as are required to be registered by this act. s. 22, 23.

If any ship or vessel shall, after registry, be altered, either in form or burthen, or in any manner whatsoever, such ship or vessel shall be registered *de novo* as soon as she returns to her port, or to any other port in which she may be registered by virtue of this act; on failure whereof such ship or vessel shall be considered as a foreign vessel. s. 24.

The owners of all such ships as shall be condemned as lawful prize, shall, upon registry thereof, before any certificate of registry shall be obtained, produce to the proper officer of the customs a certificate of the condemnation of such vessel, and also a true account in writing of all the particulars contained in the certificate herein-before set forth, to be made and subscribed by one or more skilful persons to be appointed by the court to survey such ship or vessel; and shall also make oath before the said officer, that such ship or vessel is the same ship or vessel mentioned in the certificate. s. 25.

No ship condemned as prize shall be registered in the islands of Guernsey, Jersey, or the Isle of Man, although belonging to his majesty's subjects resident in those islands; but the same shall be registered either at Southampton, Weymouth, Exeter, Plymouth, Falmouth, Liverpool, or Whitehaven, by the collector and comptroller at such port respectively. 26 G. III. c. 60. s. 26.

In all cases where any ship or vessel taken and condemned in any of his majesty's colonies, plantations, or islands aforesaid, shall be registered, and obtain a certificate, an exact account shall be subjoined thereto of the sum for which such ship or vessel shall have been sold, verified upon the

oath of the person applying for such certificate of registry. s. 27.

All certificates, hereafter to be granted in pursuance of this act, shall distinguish whether such ships or vessels be of the built of Great Britain, Guernsey, Jersey, or the Isle of Man, or of the colonies, plantations, islands, or territories aforesaid, or of any foreign country; and shall, if British built, be entitled "Certificate of British plantation registry," and if foreign built, shall be entitled "Certificate of foreign ship's registry for the European trade, British property," as the case may be. s. 28.

No ship or vessel, directed by this act to be registered, shall be permitted, after the first arrival at the port to which she belongs, at the expiration of the notice by this act directed, to clear outwards for foreign parts, or coastwise, or to proceed to sea for the purpose of fishing on the coasts, or for any other purpose, as a British ship or vessel, unless the owners thereof shall have obtained a certificate; and in case such ship or vessel depart from such port without being registered, and without having obtained a certificate, every such ship or vessel, with all her guns, furniture, ammunition, tackle, and apparel, shall be subject to forfeiture. s. 32.

If, after the expiration of the before-mentioned notice, any ship or vessel (being square rigged) shall be found in any port within 20 leagues by water from the port to which she belongs, or if any vessel, not square rigged, be found within any port other than that to which she belongs, without having a certificate of registry hereinbefore directed, it shall be lawful for the principal officer of such port, and he is hereby required to detain such until the master or commander shall, if such ship or vessel be under 50 tons, give security by bond in 50*l*. in manner hereinafter directed; and if the same shall exceed 50 and not exceed 100 tons, shall give security by bond in 100*l*.; and if the same shall exceed 100 tons, then until the master or commander shall with one security give bond in 200*l*., with condition that such master or commander shall forthwith repair with her to the port to which she belongs, and there cause her to be registered, procure a certificate, and deliver to such officer such certificate within the time limited in the condition of such bond; which time is to be fixed according to the distance of the vessel from the port to which she belongs, and the nature of the voyage in which she may be engaged; and on failure of producing such certificate, such bond shall be forfeited; but if the certificate be produced within the time so limited, such bond shall be void. And in case any square rigged vessel shall be found in port, after the expiration of the aforesaid notice, more than 20 leagues distant by water from the port to which she belongs, or that the water at the entrance of the port to which she belongs shall be so shallow as not to admit her entrance, the master or commander shall, within 48 hours after his arrival at such port, make known his arrival to the collector and comptroller of the customs, or other principal officer of such port; and shall require such collector and comptroller to cause his ship or vessel to be surveyed by the proper officer, who shall accordingly make a perfect survey, and certify the several particulars thereof; and such collector and comptroller shall immediately transmit the said certificate of survey to the person authorized to register ships and vessels at the port to which such vessel belongs, who shall register such vessel, and grant certificate of registry; and it shall be lawful for the collector and comptroller, or other principal officer of the customs, in the port where such ship or vessel shall be so found, to detain her until a perfect and accurate survey, in the manner hereinbefore directed, can be made.

The remaining sections of this act relate to penalties upon the

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the misconduct of officers, forging or altering certificates of registry, mode of recovering penalties, &c.

By 27 G. III. c. 19. f. 4, no oath taken for the sole purpose of acquiring the rights of a citizen or burgher in any foreign city or town in Europe, to be enjoyed during the time that such person taking such oath shall reside in such city or town, and for a limited time after such residence shall have expired, shall be deemed an oath of allegiance to a foreign state, nor inconsistent with the form of the oath upon registry prescribed by 7 & 8 W. III.

Ships belonging to the East India company, or any other body corporate, are to be registered upon the oath subscribed by the secretary of the said company or other body corporate, or by any other officer properly authorized. f. 7.

No vessel whatsoever, not exceeding the burthen of 30 tons, and not having a whole or fixed deck, and being employed solely in the Newfoundland fishery, or on the banks or shores of the provinces of Quebec, Nova Scotia, or New Brunswick, adjacent to the gulf of St. Lawrence, and to the north of cape Canso, or of the islands within the same, or in trading coastwise within the said limits, shall be subject to be registered in pursuance of the said act. f. 8.

Ships built in Newfoundland, and those parts of the provinces of Quebec, Nova Scotia, and New Brunswick, adjacent to the gulf of St. Lawrence, and to the north of cape Canso, or in the islands within the said limits, on account of owners residing in his majesty's European dominions, shall be registered in the above places, upon the husbands or principal agents of the said ships taking the oath required; and such certificates shall be of the same effect as if granted upon the oath of the owners, until such time as they shall arrive in port in any of his majesty's European dominions, where they may be respectively registered upon the oath of the respective owners, but no longer. And whenever such ship shall arrive at any such port in his majesty's European dominions, the certificates of registry, granted in pursuance of this act, shall be null and void, and shall be delivered up to be cancelled; and such ships are hereby required to be respectively registered *de novo* conformably to the requisitions of the preceding act. f. 9.

By 27 G. III. c. 19. f. 13, all ships not registered according to the directions and regulations of the said act, although such ships may be owned by his majesty's subjects, shall be held and deemed as alien ships, and shall in all cases be liable to such and the same penalties and forfeitures as alien ships are by law liable to in similar cases.

By 34 G. III. c. 42, foreign ships and vessels heretofore owned by subjects of the late French king, which in consequence of any capitulation may be put under his majesty's protection at the time of, or in consequence of the surrender of any foreign colony, may be registered as ships condemned as lawful prize, and shall become entitled to the privileges of British ships, under the regulations and restrictions hereafter mentioned. Provided always, that no ship shall be so registered but upon producing a certificate under the hand and seal of the person who commanded in chief, by sea or land, at the time when such foreign colony was surrendered (or in case of the death or departure of any such officer before such certificate shall have been so given, then upon a like certificate under the hand and seal of the person who shall command in chief, by sea or land, at such colony), testifying that such ship or vessel was put under the protection of his majesty at the said time; and upon oath, hereinafter directed, being taken and subscribed before the person authorized to make such registry, by the owner of such ship, if she belong to one person only; or in case there shall be

two joint owners, then by both of such joint owners, if both be resident within 20 miles of the place where such registry is required, or by one of such owners, if one or both of them shall be resident at a greater distance; or if the number of such owners shall exceed two, then by the greater part of them, if the greater number of them shall be resident within 20 miles, not in any case exceeding three of such owners, or by one of such owners, if all shall be resident at a greater distance. Provided that such registry shall, for the island of St. Domingo, be made at the port of Kingston in the island of Jamaica, and for any of the French Leeward islands, in the port of Roseau in the island of Dominica; and the said ports of Kingston and Roseau shall respectively, for the purpose of such registry, be deemed to be the port to which such ship belongs. f. 1.

His majesty, by the advice of his privy council, may at any time, on the arrival of any such ship in Great Britain, upon application made to him, authorize any such ship (without payment of any duty whatever for the said ship, or the sails and other necessary tackle, apparel, and furniture thereof) to be registered, as in the case of a prize-ship, in any port of Great Britain. f. 4.

No person heretofore a subject of the late French king, being a white person, a mulatto, or free negro, shall be employed to navigate any vessel bound from such foreign colony, to any part of his majesty's dominions, or be conveyed as a passenger on board thereof, unless such person shall produce a certificate under the hand and seal of the person who commands in chief in such foreign colony, or at the place therein whence such ship shall sail, testifying that such person has taken the oath of fidelity and allegiance to his majesty; and no negro-slave belonging to any person whatsoever, heretofore a subject of the late French king, shall be so conveyed or employed, but upon a certificate under the hand and seal of his master (which master shall have taken the oath of fidelity and allegiance as aforesaid), certifying the good character of such negro-slave, and testifying that his conduct has been such that he may be safely admitted into the ports of his majesty's dominions; which certificate shall be indorsed by the person who commands in chief his majesty's troops or vessels at the place from whence such ship shall sail, signifying that he has no reason to doubt of the truth thereof; upon pain that the master or commander of such ship shall forfeit 50*l.* for every person respectively employed or conveyed in such ship without having such certificate. f. 5.

By 34 G. III. c. 68, no goods, wares, or merchandizes whatever shall, from the expiration of six months after the conclusion of the present war, be imported into, or exported from, any port or place in Great Britain, or Guernsey, Jersey, Alderney, Sark, or Man, to any other port or place of the same, on board any ship or vessel which, by law, is or shall be required to be registered as a British ship or vessel, unless such ship or vessel shall be navigated by a master and three-fourths at least of the mariners British subjects. Nor, from the expiration of six months from the conclusion of the present war, shall any ship or vessel, which by law is or shall be required to be registered as a British ship or vessel, be navigated but by a master and three-fourths of the mariners at least British subjects, except as hereinafter provided. f. 1, 2, 3.

No goods, wares, or merchandizes whatever shall be carried from any port in Great Britain, or Guernsey, Jersey, Alderney, Sark, or Man, to any other port or place of the same, nor shall any ship be permitted to sail in ballast from or to any of the aforesaid ports, nor be employed in fishing on the said coasts, unless such ship shall be wholly and solely

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manned with and navigated by a master and mariners all British subjects. The commissioners of the customs may, however, by licence under their hands, authorize any such ship or vessel employed in fishing on the coast of Great Britain, or of the islands of Guernsey, Jersey, Alderney, Sark, or Man, to have on board any foreign mariners for the purpose of instructing the British mariners thereof in the art of fishing; such foreign mariners not exceeding one-fourth of the number of mariners on board such vessel, except in cases of sickness, death, desertion, or capture. s. 5.

By stat. 34 G. III. c. 68, no person shall hereafter be deemed to be qualified to be the master of a British ship, or to be a British sailor, seaman, or mariner, except the natural-born subjects of his majesty, or persons naturalized by any act of parliament, or made denizens by letters of denization; or except persons who have become his majesty's subjects by virtue of conquest or cession of some newly acquired country, and who shall have taken the oath of allegiance to his majesty, or the oath of fidelity required by the treaty of capitulation, by which such newly acquired country came into his majesty's possession, except as is hereinafter provided. s. 6.

But every foreign seaman serving on board any of his majesty's ships in time of war, for the space of three years, who shall also take the oath of allegiance, shall be entitled to be employed as a master of a British ship or vessel, or as a British mariner on board any British ship, upon delivering certificates from the captains under whom he served, of the time he shall have served, and of his faithful service and good behaviour, and a certificate of his having taken the oath of allegiance. s. 7.

No person who has taken an oath of allegiance to any foreign state shall be deemed qualified to be the master of a British ship or vessel, or a British sailor, unless such person shall have taken such oath of allegiance before he became so qualified; and any person who shall, after having become disqualified by taking such oath of allegiance, take the charge or command of any British ship or vessel, shall for every such offence forfeit one hundred pounds; and if such person shall engage to serve as a British seaman or mariner on board any such ship, he shall forfeit ten pounds, unless the owners shall shew that such disqualifications were unknown to them or their agents at the time of engaging such master or sailor to serve on board such ship or vessel. Except in the navigation on the seas of America and the West Indies, any negroes belonging to his majesty's subjects, and in the seas to the eastward of the Cape of Good Hope, Lascars and other natives of any of the countries to the eastward of the Cape of Good Hope, may be employed as British sailors, seamen, or mariners, in manner heretofore practised. Provided nevertheless, that no negro belonging to any person who has become a subject of his majesty, in manner before described, in any of the islands or colonies late under the dominion of the French, shall be entitled to be employed in manner before mentioned as a British sailor, seaman, or mariner, unless all the conditions required by the 34th G. III. c. 42, shall have been complied with during the continuance of the said act.

By the 13th G. II. c. 3, his majesty in time of war may permit merchant ships to be navigated by foreigners, provided one-fourth of the crew be British subjects.

If any goods, wares, or merchandize whatever shall be imported or exported, or carried coastwise, contrary to the provisions of this act, or any of them, all such goods, wares, and merchandize, and also the ship or vessel, with all her guns, furniture, ammunition, tackle, and apparel, shall be forfeited; and if any ship shall sail in ballast, or shall sail

to be employed in fishing along the coast in manner herein before mentioned, or, being required to be manned and navigated with a master and a certain proportion of British mariners, in manner herein before directed, shall not be manned and navigated accordingly, such ship or vessel, with all her guns, furniture, ammunition, tackle, and apparel, and all the goods, wares, and merchandize on board, shall be forfeited. s. 10.

All goods, wares, and merchandize, and all vessels, forfeited by this act, may be seized by the commander of any of his majesty's ships of war, or any commissioned, warrant, or petty officer specially appointed, or by any officer or officers of his majesty's customs or excise.

If any British ship shall be found at sea, having on board a greater number of foreign mariners than is allowed by this act, or any law in force or hereafter to be made, and the master of such vessel shall produce a certificate of the actual necessity of engaging such foreign mariners in some foreign port, by occasion of the sickness, death, or desertion of the like number of British mariners, or of the same having been taken prisoners during his voyage, and that British mariners could not be engaged at such foreign port to supply their place, and that for the safe navigation of such ship or vessel, it became necessary to engage and employ such foreign mariners, under the hand of his majesty's consul at the foreign port where the mariners are so engaged, or, if there be no such consul there, under the hands of two known British merchants at such foreign port, no seizures shall be made by the persons authorized under this act, nor shall such ships be molested or detained at sea; but such persons shall indorse the certificate so produced, testifying the production thereof, and when and where met with at sea, and that the number of foreign mariners correspond with the certificate of such British consul, or such known British merchants, for the consideration and investigation of the commissioners of his majesty's customs in England and Scotland respectively.

By 34 G. III. c. 68. s. 14, no transfer, nor agreement for transfer, of the property in any ship or vessel, either in whole or in part, shall be made but by a bill of sale or instrument in writing, which shall contain a recital in words at length of the certificate of registry.

If a ship be at sea at the time when the transfer is made, so that an indorsement and certificate cannot be immediately made, the sale, or contract for sale, shall, notwithstanding, be made by some instrument in writing, and a copy thereof shall be delivered to the person authorized to make registry, who is to indorse an entry thereof on the oath or affidavit, make a memorandum in the book of registers, and give notice to the commissioners of the customs as before directed: and within ten days after the ship returns to port, an indorsement shall be made on the certificate of registry, and a copy thereof delivered as before-mentioned; otherwise such sale shall, to all intents and purposes, be void. s. 16.

Where the owner of any ship shall, at the time of transferring the property in any ships, be abroad, so that an indorsement, &c. or such bill of sale, cannot be immediately made, the same may be done at any time within six months after such transfer, in which case, within ten days after the arrival of the owner or his agent in this kingdom, (if the ship be in any port thereof, and if not, within ten days after such ship's arrival) an indorsement on the certificate of registry shall be made, &c. as before directed. s. 17.

Masters of ships refusing to deliver up the certificate of registry to the proper person empowered to make registry, upon being required so to do by the owner or owners, or the major part of the owners, (if such master have not any property

perty therein,) or by the other owner or owners, or major part thereof, (if such master have any share therein,) and upon oath being made by such owner, owners, or major part thereof, before any justice of the peace near where such refusal shall be, such justice may grant his warrant to bring the master before him; and if it shall appear that the said certificate is *willfully* detained, such master shall pay one hundred pounds, and on failure of payment shall be committed to the common gaol, for not less than six months, nor more than twelve. f. 18.

Upon the justice's certifying the above *willful* refusal of the master of any vessel to deliver up the certificate to the person authorized to make registry, he shall register the said ship *de novo*, the terms and conditions of the law being complied with. f. 19.

When property in any ship or vessel belonging to any of his majesty's subjects shall be transferred by sale, and such vessel shall be required to be registered *de novo*, it shall not be done unless there be produced to the register, the bill or other instrument of sale. Provided always, that the commissioners of customs, and the governor, lieutenant-governor, or commander-in-chief for the time being of the islands of Guernsey or Jersey, or of any colony, plantation, island, or territory belonging to his majesty, may, upon due consideration of the particular circumstances of the case, give directions for the registering such vessel *de novo*, and granting a certificate of such registry, notwithstanding such bill or other instrument of sale shall not have been produced as aforesaid; and such registry shall be made, and such certificate thereof shall be accordingly granted, if all the other regulations required by the laws in force concerning the registry of ships *de novo* be complied with. f. 20.

If there shall be any alteration of property at the same port, and the owner shall be desirous of having the ship registered *de novo*, such ship may be so registered, provided all the rules, regulations, and conditions are complied with relative to vessels registered *de novo*. f. 21.

In case of any transfer of property in any ship whilst at sea, such ship shall proceed directly to the port for which the cargo then on board is destined, and shall sail from thence to the port of his majesty's dominions to which she belongs, or to any other such port in which she may be legally registered; and such ship may take on board in the port for which her original cargo was destined, or in any other port in the course of her voyage home, such cargo as may be legally carried to such port of his majesty's dominions where she may be so registered *de novo*. And if such transfer of property shall be made while such ship is in any foreign port, as soon as the master of such ship shall become acquainted therewith, such ship, after having delivered the cargo then on board at the port for which she is destined, shall sail thenceforth to the port to which she belongs, or to any other such port in which she may be legally registered; and may take on board at the port for which her original cargo was so destined, or at any other port in the course of her voyage home, such cargo as may be legally carried to such port of his majesty's dominions where she may be so registered *de novo*. And if such transfer of property shall be made while such ship is on a fishing voyage, as soon as the master of such ship shall become acquainted therewith, such ship, after having finished such fishing voyage, without touching at any foreign port, except for the purpose of repairs or refreshments, or for delivering any part of her cargo, shall sail to the port of his majesty's dominions to which she belongs, or to any other such port where she may be legally registered, and may take on board at the foreign port or ports last described, or at any other ports in the course of

her voyage home, such cargo as may be legally carried to such port of his majesty's dominions; and every such ship as aforesaid shall be registered *de novo*, as soon as she returns to the port of his majesty's dominions to which she belongs, or to any such port in which she may be legally registered by virtue of the said act; on failure whereof such ship shall be deemed from thenceforth to be a foreign ship or vessel, and shall not again be registered, or be entitled to the privilege of a British ship or vessel, unless upon special representation of the circumstances of the case to the commissioners of customs, or to the governor, lieutenant-governor, or commander-in-chief for the time being of the islands of Guernsey or Jersey, or of any colony, plantation, island, or territory to his majesty belonging, as the case may be: provided nevertheless, that in no case the ship or vessel of which the property is so transferred, shall be entitled to the privileges of a British ship or vessel, unless she shall return to the port to which she belongs, or to such other port in which she may be registered *de novo*, within the period of twelve months after the date of such transfer of property, if such ship shall not be on a voyage to the east of the Cape of Good Hope, or to the west of cape Horn; or within two years, if the ship is on the above voyages at the time such transfer of property shall take place, except by the order of the said commissioners, governor, lieutenant-governor, or commander-in-chief respectively. f. 22. See *Marine INSURANCES*, and *POLICY*.

REGIUS PROFESSORS. King Henry VIII. founded five lectures in each of our universities: *viz.* of Divinity, Hebrew, Greek, Law, and Physic; the readers of which lectures are in the university statutes called *regii professores*.

REGIUS, in *Medicine*. See **JAUNDICE**.

REGLE de l'Octave, Fr., a rule for accompanying the octave ascending and descending in the base; giving to each note of the scale its appropriate harmony in every key. This rule, well known and practised in the 24 keys, major and minor, will enable students in thorough-bass to figure a base themselves, and to accompany modern music without figures.

It is disputed in France who was the inventor of this rule: Rameau and Rousseau assign it to De Laire, M. Laborde to Campion. "This formula," says Rousseau, "was first published by De Laire in 1700." If this date could be ascertained, it would remove all doubts concerning the author of the rule; as Campion's "Treatise of Accompaniment" is not pretended to have appeared till after 1705.

This rule ascertains what chords or harmony belong to every diatonic movement of the base, ascending and descending. See **ACCOMPANIMENT**, or **THOROUGH-BASE**; where the base will be figured, and the chords written over it. We confine the infallibility of this rule to modern music, as no provision is made for 4ths and 9ths, which so frequently occur in Corelli, Geminiani, and Handel. But these discords, and several other combinations, are considered in the articles **COUNTERPOINT** and **ACCOMPANIMENT**, or *Thorough-bass*; which see.

By this formula it will appear, that to the key-note there is always a common chord; to the 2d of the key, a $\frac{6}{4}$; to the 3d of the key, a 6th; to the 4th of the key, a $\frac{6}{4}$; to the 5th of the key, a common chord. Thus far the chords are rigorously in one key; but in order to connect the 6th to the 5th, Rameau gives the chord of the $\frac{6}{4}$ to the 6th, as in descending, which makes it the 2d of a new key; but then to recover the modulation into the original key, he gives $\frac{6}{4}$ to the 7th or *not sensible* of the key, and then terminates

minates the scale by a common chord to the octave of the key-note.

In descending, it is necessary to imagine the harmony in the 5th of the key for the four first notes: as, supposing the scale to be in C major, after repeating the common chord to the octave, the 7th of C must be regarded as 3d of the key of G, and be only accompanied by the 6th. A, as 2d of G, by a $\frac{6}{4}$, as in ascending; and the 5th of the key by a common chord, or close in G. The 4th of the key in descending has a $\frac{6}{4}$, or chord of the 5th of the key repeated; the next three chords are the same as in ascending.

In minor keys, in all which supposing A natural to be the archetype, the chords are much the same; only whenever the 7th of the key is wanting in the ascending scale, it must be accidentally sharp: as to A, a common chord minor; to B, the 2d of the key, a $\frac{6}{4}$; to the 3d of the key, a 6th; to the 4th, a $\frac{6}{4}$; to the 5th, a common chord, with a sharp 3d; to the 6th, if natural, a 6th; if sharp, a $\frac{6}{4}$; to the 7th sharp, $\frac{6}{4}$ B, and a common chord to the octave.

In descending, to the 7th natural, a 6th; to the minor 6th, a $\frac{6}{4}$, or 6 doubling the 3d; to the 5th of the key, a sharp 3d; to the 4th of the key, the same chord, or $\frac{6}{4}$; and to the three last, the same as in ascending.

These chords will be more clearly comprehended in notation on the thorough-bass plates, to which we refer.

Though the *regle de l'octave* only provides for the regular ascent and descent of the bass in plain counterpoint, we know, by long experience, that it teaches more thorough-bass and counterpoint in a short time, than any other rule that has been proposed since the laws of harmony were settled. See THOROUGH-BASS, ACCOMPANIMENT, and COMPOSITION.

REGLET, or RIGLET, in *Architecture*, a little flat narrow moulding, used chiefly in compartments, and pannels, to separate the parts or members from one another, and to form knots, frets, and other ornaments.

The word is a diminutive of the French, *regle*, rule.

The reglet, according to Daviler, differs from the *fillet* and *liffel*, in that it projects equally, like a ruler.

REGLETS, or *Riglets*, in *Printing*, are thin rulers, or slips of wood, of different dimensions, placed in the chase, between the pages, and at the extremes of them, to keep them asunder, and to hold them tight.

The reglets make the chief part of what they call *the furniture of the chase*. See CHASE.

They are particularly denominated from the place they hold in respect of the pages, *head-sticks*, *gutter-sticks*, &c.

The term reglets is also used abroad for a ruler of metal, three quarters of an inch long, but which may be lengthened out by joining several together; used to separate the columns, in books that have several in the same page; as also for lines to place the notes on, in printing of music. See PRINTING.

Reglet is also used for a little thin slip of wood, occasionally, though seldom, used by compositors for the press to take off the lines from the composing-stick, and place them on the galley, where the lines are of an extraordinary length: and where the lines are at great distances, those distances are made by leaving a reglet between each line, when printed.

REGMALARD, in *Geography*, a town of France, in the department of the Orne; 9 miles E.N.E. of Bellesme.

REGNANO, a town of Naples, in Capitanata; 16 miles from Manfredonia.

REGNANT QUEEN. See QUEEN.

REGNARD, JOHN-FRANCIS, in *Biography*, a French poet and writer of comedy, was born of a good family, at Paris, in 1647. His earliest passion was that for travelling, and he first made the tour of Italy. On his return, in an English ship, the vessel was taken by the Algerines, and the crew made slaves at Algiers. Regnard, by his skill in cookery, ingratiated himself with his master: he possessed another art, which had nearly proved fatal to him. His person and manners recommended him to the attention of the ladies, whose advances he encouraged, and being discovered, the alternative was given him of being burnt to death or becoming a disciple of the Koran. He was, however, released from this difficulty by the interposition of the French consul, and the proper application of a considerable bribe. He gained his liberty, and returned to France, and in 1681 departed upon a new tour to the northern countries of Europe. After an absence of three years he came back to Paris, and settled quietly, with the view of cultivating his taste for literary pursuits. He composed a number of comedies for the French theatre, which were acted with success, and which, in the general opinion, placed him next to Moliere in true comic humour. Gaiety is the predominant character of Regnard's comedies, which is sometimes maintained at the expense of morality. He excelled not less in the elevated or genteel comedy, than in the low, or familiar. His two best pieces are said to be "*Le Joueur*," and "*Le Legataire*;" for describing, to the life, the scenes of the first, he was extremely qualified, being himself a lucky gambler. He wrote eight comedies, some pieces for the Italian theatre, and an opera. He also published miscellaneous poems, consisting of satires, epistles, &c. In prose he gave a relation of his travels, of which the only part that excited much interest was his account of Lapland. Regnard died at the age of 62. His works have been printed collectively, of which the best edition is that of Paris, in 1790, in 4 vols. 8vo.

REGNAVADSOE, in *Geography*, a small island in the North sea, near the coast of Norway. N. lat. 69° 50'.

REGNI, in *Ancient Geography*, a name given to the ancient inhabitants of Surrey and Sussex, and perhaps of part of Hampshire. They were seated E. of the Belgæ, and S. of the Atrebatii. As these people possessed so large a tract of the sea-coast in the south part of this island, it is very probable that they had come from the continent, and settled here not very long before the Roman invasion, perhaps at the same time with their neighbours the Belgæ. The Belgæ and the Regni had been near neighbours on the continent; the one having migrated from the country of the Sueffiones, now Soissons, and the other from the country of the Rhemi, now Reims. The Regni, like all the other Belgic Britons, early submitted to the Roman power, and continued steady in their obedience, without engaging in any revolt. It is not known who was sovereign of the Regni when they submitted to the Romans, but soon after their submission, they were put under the government of Cogidunus, king of the Dobuni. For this prince, who was then very young, had got so much into favour with the emperor Claudius, and his ministers, that he was not only allowed to keep his own dominions, but he had several other neighbouring states put under his authority. It seems probable, from a famous inscription discovered at Chichester, that Cogidunus governed the Regni in quality of the emperor's lieutenant, or legatus Augusti; for in that inscription he is so styled. He continued a faithful and useful friend and ally to the Romans above 60 years, and thus he was so much endeared to them, that;

that, according to their custom in other countries, they permitted his posterity to succeed him, perhaps for several generations. Although the Regni were very early and very obedient subjects of the Roman empire, yet as they were long after under the immediate government of British princes, few of the Romans seem to have settled among them. This is, without doubt, the reason that we meet with so few vestiges of those great and active people in those countries which were anciently inhabited by the Regni. Chichester was certainly a considerable place in the time of the Romans, and probably the capital of the Regni, which led the Romans to call it *Regnum*. However, Camden, Gale, Baxter, and others, are unanimous in fixing *Regnum*, the capital of the Regni, at Ringwood; but Mr. Horsley has produced several reasons for supposing it to have been situated where Chichester now stands. The *Neomagus* of Ptolemy, and the *Noviomagus* of the Itinerary, was a city of the Regni, and it is generally placed at Woodcote, near Croydon, in Surrey; though Mr. Baxter and some other antiquaries contend for *Ravenham*, in Kent. In the most perfect state of the Roman government in Britain, the country of the Regni made a part of the province called *Flavia Cæsariensis*, and was governed by the president of that province.

REGNIER, MATHURIN, in *Biography*, a French poet, was born at Chartres in 1573. He is said to have displayed, at a very early period, a great propensity to satire, which his father in vain attempted to repress by chastisement. The exercise of his satirical talents procured him patrons, among whom were the cardinal Francis de Joyeuse, and Philip de Bethune, both of whom he accompanied to Rome. By the interest of these great men he received considerable preferment in the church, but the dignity and gravity of the clerical character was no restraint upon his pleasures, and he died at the age of forty, worn out with licentious practices. The works of Regnier consist of satires, epistles, elegies, *stanzas*, odes, &c.: of these his satires are most esteemed, and they were thought to make a kind of epoch in French poetry. The poems of Regnier have been frequently printed; the best editions are those of Rouen, 1729, and of London, 1734, with remarks.

REGNIER-DESMARAIS, FRANCIS-SERAPHIN, a French author of considerable reputation, was born at Paris in 1632, of a family originally from Saintonge. Being the younger son of a numerous family, he had to depend solely upon his own exertions for making his way in the world, and he successively attached himself to several persons of rank, whom he accompanied in their travels. Making a proper use of his opportunities, he acquired a knowledge of the Italian and Spanish languages, and he became so much a master of the former, that when he attended the duke of Crequi on his embassy to Rome, in 1662, he wrote the official letters in Italian with so much purity, that they were not known to be the compositions of a foreigner. But he obtained a still greater triumph, by passing upon the academicians of *Della Crusca* one of his own odes for a newly discovered piece of Petrarch. In consequence of this he was elected, in 1667, a member of that celebrated academy. At the age of thirty-six he took ecclesiastical orders, for the purpose of enjoying a priory given him by Lewis XIV., as a recompence for his public services, and in 1670 he was admitted a member of the French Academy, in the hope that he might become a contributor in the compilation of their dictionary. Soon after this, at the request of the Jesuits, he translated from the Spanish language a treatise "On Christian Perfection." In his capacity of academician, Regnier displayed so much activity and zeal, that on the death of Mezerai, in 1684, he was appointed to succeed him as se-

cretary. When the dictionary was completed, the secretary by order of the Academy, drew up a preface, and an epistle dedicatory to the king; but, during his absence, other members, who were inspired with the desire of emulating him in this honour, procured a preference for their own productions. This disappointment drew from Regnier some critical remarks upon the rival performances, tinged with that cavilling and disputatious spirit, to which it appears he so often gave way, that he obtained the title of the *abbé Pertinax*. He was so attached to his own opinion, that he could seldom be prevailed upon to give up his point, or to drop a dispute. Fontenelle, being once present at an academical discussion, in which Regnier was warmly engaged, exclaimed, "this is a dispute that might be prevented from ever ending, and therefore it ought to be ended immediately." Regnier obtained several benefices, and would probably have been promoted to the very highest dignity in the church, had he not been suspected of translating a scene in the "Pastor Fido," which seems to inculcate a licentious morality, and likewise suspected of writing a still more objectionable copy of verses. He was occasionally employed in public business. He died at Paris in 1713, at the age of 81. He had drawn up a great many of the most important articles in the dictionary of the French academy, and he published, as the result of his long study of the principles of the French language, his "*Grammaire Française*," in 2 vols. 12mo., which is considered as a very valuable performance. His other works in prose were "*L'Histoire des Demeles de la France, avec la Cour de Rome, au Sujet de l'Affaire des Corfées*." Translations of several of Cicero's pieces. In verse he gave an Italian version of the Odes of Anacreon, and miscellaneous poems in Latin, French, Italian, and Spanish. His French poems are varied, ingenious, and well turned, but they are allowed not to possess much fire or force. We have alluded to the abbe's unyielding disposition: but it must be added, that he was steadfast in his friendships, inflexibly upright, and scrupulously veracious. The last quality, says his biographer, he nobly expressed, when, on being urged to violate the truth in favour of a man in power, and under the penalty of losing his friendship, he said, "I had rather quarrel with him than myself."

REGNO, in *Geography*, a town of Sweden, in East Gothland; 28 miles N. of Nordkiöping.

REGNO, *Ne exeat*, in *Law*. See *NE exeat*, &c.

REGNUM. See **REGNI**.

REGNUM Ecclesiasticum, a denomination given to one of the two kingdoms, which the clergy supposed to have existed in some countries: this, they pretended, was absolute and independent of any but the pope, comprehending ecclesiastical men and causes, and exempt from the secular magistrature: the other was a *regnum seculare* of the king or civil magistrate, which was subordinate and subject to the ecclesiastical kingdom: but these usurpations were exterminated here by Henry VIII. 2 Hale's Hist. P. C. 324.

REGNY, in *Geography*, a town of France, in the department of the Rhône and Loire; seven miles E. of Roanne.

REGOLA, Ital., a rule in music, a canon.

REGOLA Armonica, a monochord.

REGOLETS, in *Geography*, a passage from the gulf of Mexico into lake Pontchartrain, about ten miles long, and three or four hundred yards wide.

REGRADATION, **REGRADATIO**. See **DEGRADATION**.

REGRATOR, **REGRATARIUS**, a law-word, formerly used for one that bought wholesale, or by the great, and sold again by retail.

The

The term is now chiefly used, as it is described by stat. 5 & 6 Edw. VI. cap. 14. to denote one that buys corn, or other dead victuals, in any market, and sells them again, in the same market, or within four miles of the place.

Regrating is an offence against the public, and is liable, by the statute just cited, to the same penalty with engrossing and foretelling.

REGRATOR is also used for a person who furnishes up old moveables, to make them pass for new. See FRIPPERY.

Among masons, &c. to regrate is to take off the outer surface of an old hewn stone, with the hammer and ripe, in order to whiten and make it look fresh again.

REGRESSION, or RETROGRADATION of curves, &c. See RETROGRADATION.

REGINY, in *Geography*, a town of France, in the department of the Morbihan; five miles N.W. of Josselin.

REGULA. See RULE.

REGULA, in *Architecture*. See REGLET.

REGULAR, REGULARIS, denotes the relation of any thing that is agreeable or conformable to the rules of art.

In this sense, the word stands opposed to *irregular*, or anomalous.

Thus we say, a regular proceeding, a regular building, regular poem, regular verb, &c.

REGULAR *Figure*, in *Geometry*, is a figure which is both equilateral and equiangular; *i. e.* whose sides, and consequently its angles, are all equal.

The equilateral triangle and square are regular figures. All other regular figures, consisting of more than four sides, are called regular polygons.

Every regular figure may be inscribed in a *circle*; which see.

For the dimensions, properties, &c. of regular figures, see POLYGON.

REGULAR *Body*, called also *Platonic body*, is a solid terminated on all sides by regular and equal planes, and whose solid angles are all equal.

The regular bodies are five in number; *viz.* the *cube*, which consists of six equal squares; the *tetrahedron*, or regular triangular pyramid, having four equal triangular faces; the *octahedron*, having eight; the *dodecahedron*, having twelve pentagonal faces; and the *icosaedron*, having twenty triangular faces. See each under its proper article. Besides these five, there can be no other regular bodies in nature.

To measure the surface and solidity, &c. of the five regular bodies.—The solidity, &c. of the cube is shewn under the article CUBE. The tetrahedron being a pyramid, and the octahedron a double pyramid; and the icosaedron consisting of twenty triangular pyramids; and the dodecahedron of twelve quinquangular ones, whose bases are in the surface of the icosaedron and dodecahedron, and their vertices meeting in a centre; the solidities of these bodies are all found from what we have shewn under PYRAMID.

1. Their surface is had by finding the area of one of the planes, from the lines that bound it; and multiplying the area thus found by the number from which the body is denominated: *e. gr.* for the tetrahedron, by 4; for the hexahedron, or cube, by 6; for the octahedron, by 8; for the dodecahedron, by 12; and for the icosaedron, by 20. The product is the superficial area.

Or, the superficial contents of any of the five Platonic bodies may be had by the following proportion; as 1 is to the square of the side of the given Platonic body,

so is $\left\{ \begin{array}{l} 1.7320508 \\ 3.4641016 \\ 6.0000000 \\ 8.6602540 \\ 20.6457788 \end{array} \right\}$ to the superficial content of the $\left\{ \begin{array}{l} \text{tetrahedron.} \\ \text{octahedron.} \\ \text{hexahedron.} \\ \text{icosaedron.} \\ \text{dodecahedron.} \end{array} \right\}$

Hence we have the following rule: multiply the proper tabular area, taken from the preceding table, by the square of the side of the given solid, for the superficies.

2. The diameter of a sphere being given, to find the side of any of the Platonic bodies, that may be either inscribed in the sphere, or circumscribed about the sphere, or that is equal to the sphere.

As 1 is to the number in the following table, respecting the thing sought, so is the diameter of the given sphere to the side of the Platonic body sought.

The diameter of a sphere being unity, the side of a	That may be inscribed in the sphere, is	That may be circumscribed about the sphere, is	That is equal to the sphere, is
Tetrahedron	0.816497	2.44948	1.64417
Octahedron	0.707107	1.22474	1.03576
Hexahedron	0.577350	1.00000	0.88610
Icosaedron	0.525731	0.66158	0.62153
Dodecahedron	0.356822	0.44903	0.40883

3. The side of any of the five Platonic bodies being given, to find the diameter of the sphere, that may be inscribed in that body, or circumscribed about it, or that is equal to it. As the respective number, in the above table, under the title, *inscribed, circumscribed, or equal*, is to 1, so is the side of the given Platonic body to the diameter of its inscribed, circumscribed, or equal sphere, in solidity.

4. The side of any of the five Platonic bodies being given, to find the side of either of the Platonic bodies, which are equal in solidity to that of the given body. As the number under the title *equal*, against the given Platonic body, is to the number under the same title, against the body whose side is sought, so is the side of the given Platonic body to the side of the Platonic body sought.

5. To find the solid contents of any of the five Platonic bodies. As 1 is to the cube of the side of any of these bodies, so is 0.1178513 to the solid content of a tetrahedron, 0.4174045 to that of the octahedron, 1.0000000 to that of the hexahedron, 2.1816950 to that of the icosaedron, and 7.6631189 to the solid content of the dodecahedron.

Hence we have the following rule: multiply the tabular solidity by the cube of the side or linear edge, for the solid content. The demonstration of this rule, and that for the superficies above given, is as follows:

The tabular numbers denote the surface and solidity of each body, when its side or edge is one; and, because, in similar bodies, the surfaces are as the squares of the linear edges, and the solidities as the cubes of the same, the truth of the rules is manifest.

If one of these bodies be required to be cut out of the sphere of any diameter, let *dr* (Plate XII. *Geometry*, fig. 9.) be the diameter of any sphere, and *da* one-third of it, = *ab* = *br*. Erect the perpendiculars *ae*, *cf*, and *bg*; and draw *de*, *df*, *er*, *fr*, and *gr*; then will (1) *re* be the side of the tetrahedron; (2) *df*, the side of the hexahedron; (3) *de*, the side of the octahedron; (4) and cutting *de* in extreme and mean proportion in *h*, *dh* will be the side of the dodecahedron; (5) setting the diameter *dr* up perpendicular at *r*, from the centre *c*, to its top, draw the line *cg*, cutting

cutting the circle in g , let fall the perpendicular gb ; so is br the side of the isofahedron.

REGULAR Curve. See **CURVE**.

REGULAR Architecture, Fortification, &c. See **ARCHITECTURE**, and **FORTIFICATION**.

REGULAR Attacks, in a siege, are those that are made in form, or by regular approaches. See **PARALLELS**.

REGULAR Bastion. See **BASTION**.

REGULAR Place. See **PLACE**.

REGULAR, in the *Monastic Sense*, denotes a person who has made the vows in some religious house. See **RELIGIOUS** and **VOW**.

Under regulars are comprehended the whole body of monks, friars, and mendicants, &c.

The denomination of regulars, in this case, arises hence, that they are bound to observe the regula or rule of the order they are entered into. Hence,

REGULAR Priest is used for a priest who is in some religious order, in opposition to a *secular* priest, who lives in the world, or at large.

A cardinal is reputed both regular and secular, and is intitled to the privileges of both states.

Regulars may be promoted to bishoprics and archbishoprics, as well as seculars; but their promotion secularizes them; the episcopal dignity dispensing them from the observance of the rule of which they had before made profession.

REGULAR Abbots. See **ABBOT**.

REGULAR Benefices, are such as can only be held by monks or religious; or at least, *per cupientem profiteri*, by a person desirous to embrace the monastic life. See **BENEFICE**.

It is a maxim in the Romish canon law, *regularia regularibus*, i. e. regular benefices are to be conferred on regular priests. The abbeys that are chiefs of their respective orders are all regular, and can only be served by monks and cardinals. All benefices are presumed to be secular, unless they be proved regular.

Anciently the regular benefices were almost all conferred by way of administration or curacy; the religious incumbents being always *ad manum* to their superiors, who displaced them at pleasure. Hence the common maxim among the canonists, *omne beneficium regulare manuale*.

The benefices appropriated to regulars are abbeys, conventual priories, simple priories, and claustral offices. They may be conferred on seculars *in commendam*.

REGULAR Canons. See **CANON**.

REGULAR Places, are those within the boundary or inclosure of the convent; as the cloister, dormitory, chapter, and refectory. In opposition to those destined for guests, and for the necessaries of the house, which are reputed without the inclosure.

REGULAR Corporation. See **CORPORATION**.

REGULATION, a rule or order prescribed by a superior, for the uniform and orderly management of some branch of policy, justice, or the like.

REGULATOR of a Watch, is a small spring belonging to the balance, serving to adjust the going, and to make it go either faster or slower.

REGULATOR of Velocity, in *Mechanics*, is a contrivance for regulating or governing the motion of a mill, or other large machine, by means of which it will always be caused to preserve an equable and regular velocity in the motion of its parts, notwithstanding any accidental increase of the moving force, or decrease of the resistance that may occasionally arise. A regulator must be connected with some lever, or other parts of the machine, which commands the

supply of whatever constitutes its moving force, as the shuttle of a water-wheel, the sail-cloth of a wind-mill, or valve of a steam-engine; and it should have the property of acting suddenly upon this lever, or other part, the instant any increase or decrease of velocity in the motion takes place, either to elevate or depress it, and thus regulate the supply in a degree proportioned to the quantity of alteration in the velocity; and it is by the sensibility and accuracy of the regulator in this respect that its perfection is eliminated.

The regulator most commonly used is called a *governor*. This consists of two or more pendulums suspended from joints, which are supported upon a vertical axis: this being caused to revolve by the machine, and the pendulums accompanying it, the balls will, by the centrifugal force, recede from the axis or centre a quantity proportioned to the velocity of the motion and length of the pendulum: then, on any accession of the motion, they recede still further from the axis, or *vice versa*, if the velocity diminishes. This motion is contrived to actuate the lever which regulates the velocity of the machine in a steam-engine: it is connected with the valve which admits the steam from the boiler to the cylinder, in a water-wheel with the shuttle, through which the water flows, or in a wind-mill with the mill-stones, or sail-cloths. See a farther description under **MILL-WORK**, **STEAM-Engine**, and **WINDMILL**.

The principle of the governor is the same with the circular or conical pendulum, of which Huygens has laid claim to the invention, as well as of the long pendulum for regulating clocks, who says he discovered it nearly at the same time as the other. The conical pendulum circulates seconds when of the same length with the common pendulum, which will vibrate only half seconds. To explain it, we must suppose a ball or weight to be suspended by a string or rod, so that the ball can describe in a horizontal circle by a motion of the rod round a vertical axis, with which the centre of suspension coincides. In this motion the rod of the pendulum will describe the surface of a cone, of which the point of suspension is the vertex, and the horizontal circle which the ball describes is the base: it is hence called the circular or conical pendulum. The ball has liberty to recede from, or approach to, the axis, by moving upon its centre of suspension, and thus the circle the ball describes will be enlarged or diminished; and it is this circumstance which gives it the property of circulating or performing a revolution always in the same space of time which a simple pendulum of four times the length would vibrate; for this takes place equally whether the ball is extended to describe a large circle, or retracted to revolve in a small one; though, it should be observed, that this is only true in the supposition that the pendulum-ball, in moving from the vertical axis upon its centre, will describe a parabola instead of a circle, in the same manner as the ball of a common pendulum is required to move in the arc of a cycloid instead of a circle, to cause all the vibrations, both long and short, to be performed in equal spaces of time. Mr. Martin has, in his *Institutions*, given a very complete explanation of the principle of this pendulum, by supposing an inverted parabola, with its axis placed in a vertical position; then supposing a bowl or vessel excavated by the revolution of this figure upon its axis a paraboloid will be formed. A heavy globe or ball being put in this bowl, may, by agitating the vessel, be caused to perform a revolution in a horizontal circle within the vessel, and it will be found to circulate in the same period of time, whether it describes a small circle near the bottom of the vessel, or a large circle in its upper part, where the diameter is larger.

REGULATOR.

The governor or flying-ball is the regulator most generally used in machinery, although there are other means which, in particular instances, are preferable, from the circumstance of their possessing a greater power to operate upon the regulating part of the machine. One of these, called the water-regulator, consists of a pump, which, being worked by the machine, will raise water into a cistern, from which a constant stream flows off by a pipe and cock; a float is placed upon the surface of the water in the cistern, and this communicates with the steam-valve of the engine, or shuttle of the water-wheel. The operation of this regulator is easily explained, for the pump will raise a quantity of water exactly proportioned to the velocity of the machine, or the number of strokes it makes; whereas the stream which flows off by the cock is a constant quantity, and equal to that which the pump will supply when the machine moves with its intended velocity. When this is the case, the surface of water in the cistern will stand at the same height; but if the velocity is increased, the pump will raise more water into the cistern than the pipe and cock will carry off, and the surface rising, elevates the float, which, by its action, to diminish the supply of power to the machine, will correct the acceleration which has taken place in its velocity. The opposite effect takes place if the velocity decreases, *viz.* that the supply to the cistern being diminished whilst the efflux is constant, the surface will sink, and the float descending, opens the valve or shuttle, and increases the supply of power to the machine until it regains the original velocity. The great advantage of this regulator is, that it can so readily be made to keep the machine steady at any velocity which may be required, and this by merely opening or closing the cock: thus, if it is opened to carry off a greater quantity, the surface will subside, and the float, by descending, opens a greater supply of power to the machine, and occasions it to move quicker; but this, though it raises more water by means of the pump, will not raise the surface of the water in the cistern to so great a height as it stood at before, because the efflux is now equal to the increased supply.

In all cases this regulator will cause the machine to work at such a rate, as to make the pump raise the same quantity of water as the cock emits, and its rate may be ascertained before it is put to work; for if the quantity of water which the cock will discharge in a minute, or other given space of time, is known, and the dimensions of the pump; then it may easily be calculated what number of strokes *per* minute the pump must make to raise an equal quantity of water. The sensibility of this regulator will be increased by making the cistern of a small size, because then any deviation from the intended rate of working will cause the greater elevation or depression of the surface, and a greater action on the float: and, for the same purpose, it is best to make the cistern gradually diminish in area, so as to be smaller both towards the top and at the bottom, than at the place where the surface is expected to stand when the machine moves with the proper velocity. By this means it will rise or fall more rapidly, in consequence of the diminished area of the cistern, when the alteration of velocity is considerable, and a greater correction is required, than when the alteration is only trifling. It is necessary that the pump should raise a constant stream of water into the cistern, both in the ascent and descent of its bucket: to do this, two pumps, acting alternately, may be used, or by a very simple contrivance a single pump may be made to effect the same; thus, upon the rod of the pump a cylinder of wood is fixed, which is of such a diameter, that its area is equal to half the area of the pump-barrel, and its

length being equal to the length thereof, its content will be equal to one-half of the barrel: this is fixed on such a part of the rod, that it will, by the rising and falling of the rod, be drawn up out of water as much as the rod and bucket moves: now, when the pump-bucket is drawn up, the rising of the cylinder above the surface of the water increases the capacity of the cistern one-half as much as the quantity of water which is thus drawn up into it, and the efflux of water by the cock being just equal to the other half, the surface will be stationary; and when the bucket descends, and no water is raised, the cylinder going down into the water diminishes the capacity of the cistern a quantity equal to the quantity of water which will flow off in the same time, and thus supplies the waste of water which flows off in the same time. A regulator of this kind may, in many cases, be formed from some part of the machine, without any additional apparatus: thus, the cold water-pump of a steam-engine will raise the necessary water into a cistern for the float to act in, and this float must be connected with the arm of the steam-valve. Also, in an engine for blowing a furnace, where it has a water-regulator (see BLOWING), the rise of the water in the external cistern may regulate the motion of the engine, the whole machine being of the same kind with the regulator we have described.

A regulator would be applied with great advantage to a machine which is used in the *Cotton MANUFACTURE* (see that article), for drawing a piece of cotton cloth regularly and slowly over a red-hot cylinder of iron by two rollers, from one of which it is wound to the other: now, if the men who turn these stop but for a moment the cloth is burnt through, but by a regulator it might be lifted off the hot iron the instant the motion was so far diminished as to endanger the firing of it.

The water-regulator is rendered more powerful by suspending the cistern from the end of a lever, like a scale-beam, the opposite end of which has a counterpoise sufficient to balance the weight of the cistern when the water in it stands at the intended height; but if the water increases in the cistern from the causes above described, the box will descend, and the motion of the lever will act upon the machine to make the regulation the same as the motion of the float: on the other hand, when the water in the cistern diminishes, the counterpoise will draw it up and give motion to the lever. The water from the pump is introduced to the cistern by a spout, and all the other parts have the same construction as we have described.

It is a defect of both the regulators we have above described, that they do not operate upon the machine until the alteration of velocity has actually taken place, although they immediately correct it. It would be desirable to have others which would make the correction before the evil takes place: for instance, in a wind-mill, which is more subject to irregularity than any other machine, a large vane may be suspended by a heavy pendulum, and opposed to the wind; now the force of the latter, when blowing regularly, will cause the pendulum to incline a certain quantity from the perpendicular; but if the wind increases or diminishes, it will incline more or less, and this motion may be communicated to the shuttle which regulates the feed of corn, so as to give more or less to the stones in proportion to the power of the wind for grinding it, thus adapting the resistance to the power; and if this should increase beyond all bounds, the same motion may be made to act upon the grip of the mill to check its acceleration effectually. In the same manner a water-wheel may have a float placed in the dam or head to act upon the shuttle whenever the surface thereof rises or falls above or below

below the intended level, so as to apportion the supply to the fall, and keep the velocity uniform.

There is another kind of regulator sometimes used in machines to cause a sufficient resistance to the motion to prevent acceleration, such as a crane or lowering machine, which is to let down a heavy weight, a coal winding machine, &c.; a very good one for these purposes is a vertical axis with pendulums, like the governor, but having a broad vane to meet the air instead of heavy balls, which indeed may be added also: this, when put in motion, will oppose a very great resistance to the acceleration, because the centrifugal force causing the vanes to recede from the centre, they must describe a larger circle in the air in proportion to the velocity, or, by collapsing, they make but little resistance when the velocity is small.

REGULO, a title given to the sons of the emperor of China.

REGULUS, MARCUS ATILIIUS, in *Biography*, a celebrated Roman general, was raised to the consulship the first time in the year 267 B. C., and, in conjunction with his colleague Libo, obtained the honour of a triumph on account of their success over the Salentines, from whom they took their capital Brundisium. During the first Punic war the Romans elected Regulus consul, together with Lucius Manlius Vulso, B. C. 256, and gave them orders to carry their arms into Africa. They sailed with a very powerful fleet, and in their voyage encountered a superior Carthaginian force, under Hanno and Hamilcar, which they totally defeated. After resitting in Sicily, and taking fresh troops aboard, the consuls sailed for the African coast, where they took possession of the town of Clupea. They next advanced towards Carthage, which city was thrown into the utmost consternation by this unexpected invasion; and, after plundering the country almost to its gates, they returned to Clupea loaded with booty of all kinds. Very soon after this, orders arrived from Rome for the return of Manlius, leaving Regulus with part of the fleet and army to conduct the war in Africa. Regulus asked for his recall upon the following plea: he was possessed of a farm of seven acres, from which his family derived their subsistence, and being informed that his servants were carrying off his stock, he begged that he might return to save his family from starving. The plea was over-ruled, by an order that they should be maintained by the public during his absence upon the service of his country. He again advanced towards Carthage, crossed the river Bagrada (in passing which, according to the Roman historians, he was encountered by a monstrous serpent,) and laid siege to a town not far from the metropolis. Hamilcar attempted to relieve the place, but Regulus met him and gave him a very signal defeat. After this he took several towns, without any resistance. A revolt of the Numidians reduced the Carthaginians to still greater distress, so that it appears the enemy fought for peace. The terms, however, offered by Regulus were so unreasonable, that the senate of Carthage could not for a moment listen to them, and resolved upon a vigorous prosecution of hostilities. During the interval of negotiation a body of Greek mercenaries arrived at Carthage, commanded by Xantippus, a Spartan, by whom the Romans were completely defeated, with the loss of 30,000 men, besides 15,000 taken prisoners, among whom was Regulus himself, whom the Carthaginians brought in triumph into that city, which, but a few hours before, he had not only insulted, but, in his own mind, devoted to destruction. Hitherto, says the historian, Regulus had appeared only as a Roman commander, and not one of the most conspicuous; the concluding scenes of his life are those

which entitle him to rank among the first of Roman patriots. The Carthaginians behaved to their other prisoners humanely, but Regulus they treated with all the barbarity which they could devise; but, when the fortune of war appeared to turn against them, they began to use him with more lenity, in order that they might engage him to endeavour to obtain an accommodation. At their desire he went with their ambassadors to Rome, having first taken an oath that he would return to his prison, if the negotiation should not succeed. When he arrived at the gates of the city he refused to enter, being, as he said, a slave to the Carthaginians; and when his wife and children came out to meet him, he viewed them as strangers, and declined their caresses. The senators assembled to give audience to the Carthaginian ambassadors, pressed him to take his seat among them, but he refused, till commanded by his masters to accept it. When he was called on for his opinion, he spoke strongly both against granting the Carthaginians peace, and exchanging himself and the other Roman captives for the prisoners of importance whom they had taken from that nation. Though convinced by his arguments, the senators were unwilling to send back so noble a citizen, and a subterfuge was suggested to him by which he might be released from his oath, but he instantly rejected the base suggestion, and declared his resolution to return to Carthage in the face of the cruel punishment that he knew awaited him. Acting upon the idea that he was still a slave, he took no leave of his family, but, with an unmoved countenance, made his way in silence through the crowds of his admiring countrymen. The Carthaginians were told that their offers of peace were not only rejected at Rome, but chiefly so through the means of Regulus, whom now they resolved to punish in the severest manner possible. For some days he was exposed to the rays of a meridian sun, and afterwards confined in a barrel, whose sides were every where filled with large iron spikes, till he died in the greatest agonies. His sufferings were heard of at Rome, and the senate permitted his widow to inflict whatever punishment she pleased on some of the most illustrious captives of Carthage, and she took a severe revenge, till at last the senate interposed, and put a stop to the barbarity of her punishments. Regulus perished in the year B. C. 251. Univ. Hist.

REGULUS, *Petty King*, in our *Ancient Customs*, is a term frequently used, in the Saxon councils, for comes or count.

Hence *sub-regulus* was also used for a vice-comes or viscount: though in many places the two seem used indifferently for the same dignitary. Thus in the archives of the cathedral of Worcester, Uthredus sometimes styles himself *regulus*, and sometimes *sub-regulus*, of the city of Worcester.

But in other places we find a distinction: "Offa, rex Merciorum; Uthredus, *regulus*; Aldredus, *sub-regulus*, &c."

REGULUS, *König*, Germ., in *Chemistry*, denotes, in its most extensive sense, a metal in the proper metallic state. The term is now little used, though the old chemists chiefly employed it as a distinctive appellation in those cases where a metal and one of its ores happened to be called by the same name. Thus, the grey sulphuret of antimony was not known by the name of antimony long before it was suspected to contain a peculiar metal; when this discovery took place, the metal was called *regulus* of antimony, in order to distinguish it from the ore from which it was procured. For the same reason, the metals arsenic and cobalt were denominated the *reguli* of arsenic and cobalt.

REGULUS of *Antimony*. See ANTIMONY.

REGULUS, *Martial, of Antimony.* See ANTIMONY.

REGULUS of *Arsenic.* See ARSENIC.

REGULUS of *Cobalt.* See COBALT.

REGULUS, in *Astronomy*, is a star of the first magnitude, in the constellation Leo; called also, from its situation, *Cor Leonis*, or the *Lion's Heart*; by the Arabs, *Albabor*; and by the Chaldeans, *Kalbeceel*, or *Kalbeceid*; from an opinion of its influencing the affairs of the heavens; as is observed by Theon. See LEO.

REGULUS, in *Ornithology*, a species of *Falco*; which see. —Also, a species of *Motacilla*; which see. —See also WREN.

REGUSSE, in *Geography*, a town of France, in the department of the Var; 9 miles N.E. of Barjols.

REGYA, a river of Africa, which runs into the Mediterranean; 16 miles E. of Algiers.

REHABERE *facias seifnam*, quando vicecomes liberavit seifnam de majore parte, *quam deberet*, in *Law*, a writ judicial; of which there is another of the same name and nature. (Reg. Jud. 13, 51, 54.) It lay when the sheriff in the *Habere facias seifnam* had delivered more than he ought.

REHABILITATION, REMABILITATIO, in the *Civil* and *Canon Law*, an action by which a prince or pope, by dispensation or letters patent, restores a delinquent to the condition he was in before his delinquency. See DEGRADATION.

The king alone can rehabilitate an officer, noted, condemned, and degraded; or a gentleman who has derogated from his rank.

The pope alone pretends to rehabilitate, *i. e.* to render capable of benefices and orders, such as had fallen into heresy or other irregularities.

In Romish countries, an ecclesiastic who assists at the execution of a sentence of death, is to be rehabilitated by an absolution, called a *sevis*.

By the *rehabilitation* of a convict in the Code Napoleon, or French criminal jurisprudence, is understood his restoration to all the rights and privileges which he had forfeited by being subjected to a painful or infamous punishment. He cannot demand it till five years have elapsed since the execution of his sentence, during the whole of which time he must have resided in the same *arrondissement*; or unless he has been domiciled during two complete years in the territory of the municipality to which the demand is addressed. It must also be supported by testimonials of his good conduct from the municipal authorities. The criminal court receives the demand, and pronounces on it at the end of three months: if their judgment be unfavourable, the application may be renewed at the end of five years, with the same advantage; but if the party rehabilitated into society should offend again, he becomes incapacitated for ever.

REHBURG, in *Geography*, a town of Westphalia, in the principality of Calenberg; 18 miles W.N.W. of Hanover.

REHEARING, in the *Court of Chancery*, is a process to which either party, that thinks himself aggrieved, may have recourse, before the execution of a final decree. Every petition for a rehearing must be signed by two counsel of character, certifying that they apprehend the cause is proper to be reheard. And upon the rehearing, all the evidence taken in the cause, whether read before or not, is now admitted to be read; because it is the decree of the chancellor himself, who only now sits to hear reasons why it should not be enrolled and perfected; at which time, all omissions of either evidence or argument may be supplied. But after the decree is once signed by the chancellor, and enrolled, it cannot

not be reheard or rectified, except by bill of review, or by appeal to the house of lords.

REHEARSAL, in *Musick* and the *Drama*, an essay or experiment of some composition, which is made in private, previous to the representation or performance of it in public; to habituate the actors or performers, and make them more ready and perfect in their parts.

REHOBOTH, in *Geography*, a post-town of America, in Bristol county, Massachusetts, on a branch of Providence river, a few miles from Providence, in Rhode island, 40 miles southerly from Bolton. It was called "Seconnet" by the Indians; incorporated in 1645, and contains 4866 inhabitants.

REHUT, a town of Hindoostan, in the circar of Gohud; 20 miles S.S.W. of Gwalior.

REI *Domestice Domesticus.* See DOMESTICUS.

REICH, in *Geography*, a town of Austria; 7 miles N.W. of Schwaneftadt.

REICHARDT, JOHN FREDERIC, in *Biography*, chapel-masser to Frederic II. king of Prussia, at Berlin, was born at Königsberg, in Prussia, in 1751, and studied under the organist of the principal church. Richter taught him the harpsichord, and formed his taste. He likewise practised the violin, and was powerful upon that instrument, particularly in double stops. With these talents he travelled in 1771, distinguishing himself in Upper and Lower Saxony, Dresden, Leipzig, Brunswick, Hamburg, and Berlin; where he was appointed by the king, in 1775, chapel-master, in the station which Graun had formerly illustrated.

The first composition which he produced in his new office, was a prologue to Graun's opera of "*Angelica e Medoro*," which he set on occasion of a visit to the king of Prussia by the grand duke of Russia, in 1776; in which prologue he composed the famous air "*Nell' orror d'Atra Foresta*," for Mad. Mara.

In 1783 he went to Paris, and gave proofs of his abilities at the concert spirituel; and in 1784, he was present at the commemoration of Handel in London. He married the daughter of Francis Benda, born the same year as himself, an excellent singer.

REICHELIA, in *Botany*, Schreb. Gen. 200. (Sagonea; Aubl. Guian. t. 111. Juss. 134. Lamarck Illustr. t. 212.) Reduced by its author, on the suggestion of Swartz, to *Hydrolea*; Schreb. 826. There have been two botanists of the name of Reichel; but Schreber, most probably, had principally in view George Christian Reichel, professor of medicine at Leipzig, who published a dissertation on the Spiral Vessels of Plants, and died in 1771, at the age of 44.

REICHELSBERG, in *Geography*, a lordship of Germany, in the circle of Franconia, deriving its name from a mountain citadel, near the town of Aube, in the duchy of Wurzburg.

REICHELSBURG, a town of the duchy of Wurzburg; 20 miles S.E. of Wurzburg.

REICHELSDORF, a town of Bavaria, in the territory of Nuremberg; 7 miles S. of Nuremberg.

REICHELSHEIM, a town of the duchy of Wurzburg; 4 miles W. of Arnstein.—Also, a town of the principality of Nassau Weilburg, insulated in the bishopric of Fulda; 30 miles S. of Marburg.

REICHELSWAND, a town of Bavaria, in the territory of Nuremberg; 3 miles E. of Lauf.

REICHENAU, an island in the lake of Constance, about two miles long, and abounding with vines and other fruit

fruit trees, with a celebrated abbey, and the villages of Upper and Lower Zell.—Alfo, a town of Bohemia, in the circle of Chrudim; 9 miles W.N.W. of Politzka.—Alfo, a town of Auftria; 5 miles S.W. of Freyftadt.—Alfo, a town of Saxony, in the Vogtland, near Pawfa.—Alfo, a town of the Helvetian republic, at the union of the two branches of the Rhine; 6 miles S.W. of Coire.—Alfo, a town of Bohemia, in the circle of Bechin; 6 miles E. of Rosenburg.—Alfo, a town of Bohemia, called "New Reichenau," in the circle of Bechin; 8 miles E.S.E. of Pilgram.—Alfo, a town of Pruffia, in the province of Oberland; 8 miles S.E. of Ofterrod.—Alfo, a town of Pruffia, on the Olla; 22 miles E.N.E. of Cuhm.

REICHENBACH, a town of Saxony, in the Vogtland, containing about 700 houfes, two churches, and a Latin fchool. The inhabitants are chiefly clothiers, and dealers in cloth. Their method of dyeing is held in high eftimation, the moft beautiful fcarlet in the whole electorate being made at this place; 10 miles S.W. of Zwickau. N. lat. $50^{\circ} 31'$. E. long. $12^{\circ} 16'$.—Alfo, a town of Silefia, in the principality of Schweidnitz, containing two churches and an hofpital. The town has fome confiderable manufactures of linen, canvas, and fuffian; 9 miles N. of Schweidnitz. N. lat. $50^{\circ} 35'$. E. long. $16^{\circ} 35'$.—Alfo, a town of France, in the department of the Sarre; 8 miles S. of Lautereck.—Alfo, a town of Lufatia; 4 miles S.W. of Camenz.—Alfo, a town of Pruffia, in the province of Oberland; 7 miles S.S.W. of Holland.—Alfo, a town of Germany, in the county of Henneberg; 3 miles N. of Smalkalden.—Alfo, a town of Germany, in the principality of Culmbach; 12 miles E.N.E. of Neuftadt.—Alfo, a town of Germany, in the margraviate of Anfpach; 2 miles N.W. of Schwabach.

REICHENBERG, a mountain of Swabia; 6 miles N.W. of Huißingen.—Alfo, a town of Bohemia, in the circle of Boleflaw. Twenty thoufand pieces of cloth are fuppofed to have been made in this town in one year; 25 miles N.N.E. of Jung-Buntzlau.—Alfo, a town of Pruffia, in the province of Ermeland; 3 miles S.W. of Heilsberg.—Alfo, a town and caſtle of Weſtphalia, in the county of Catzenelnbogen; 5 miles E. of St. Goar.

REICHENBURG, a town of the duchy of Stiria; 12 miles S.S.E. of Cilley.

REICHENECK, a town of the duchy of Stiria; 5 miles E.S.E. of Cilley.

REICHENFELS, a town with a caſtle in Saxony, in the principality of Reuffen; 8 miles N.W. of Greitz.—Alfo, a town of the duchy of Carinthia; 24 miles N.E. of Clagenfurt.

REICHENHALL, a town of Bavaria, on the Sala, with a rich falt ſpring, the water of which is partly boiled here, and partly, by means of a large wheel 36 feet in diameter, thrown up to the higher parts of a lofty houſe, and thence conveyed by means of leaden pipes to the diſtance of 12 miles, over mountains, towards Traunſtein, and there boiled, on account of the convenience of wood, and alfo of exportation. An aqueduct of ſquared flints, two miles long and five feet broad, with an arched roof, was formed ſome centuries ago, for conveying water to turn the wheels and other engines, and to carry off any ſuperfluous falt water. This aqueduct, after running to a depth of 12 fathoms under the town, and from thence under the gardens and fields, at laſt diſcharges its water in a ſtrong torrent. The current of the water is ſo ſtrong, that a boat with torches may fail from one end to the other in a quarter of an hour. In the aqueduct are five apertures in the form of towers, and through ſome of theſe a perſon may ſpeak from the ram-

parts of the town with thoſe who fail upon the canal; 9 miles S.W. of Salzburg. N. lat. $47^{\circ} 40'$. E. long. $12^{\circ} 50'$.

REICHENSTAIN, a town of Auftria; 19 miles N.E. of Steyregg.

REICHENSTEIN, a town of Silefia, belonging to the principality of Brieg, but inſulated in that of Munſterberg; 16 miles W. of Neiße. N. lat. $50^{\circ} 15'$. E. long. $16^{\circ} 40'$.—Alfo, a town of France, in the department of the Roer; 21 miles S. of Juliers.

REICHENSTEIN, *Unter*, a town of Bohemia, in the circle of Prachatitz; 3 miles W.S.W. of Berg Reichenſtein.

REICHENTAL, a town of Auftria; 3 miles E. of Haderdorf.

REICHENWALT, or RIECHERSWALDE, a town of Pruffia, in Oberland; 4 miles N.W. of Liebitat.

REICHERSDORF, a town of Tranſylvania; 4 miles E. of Medies.

REICHMANSHAUSEN, a town of the duchy of Wurzburg; 10 miles E.N.E. of Schweinfurt.

REICHNAW, a town of Bohemia, in the circle of Koniggratz; 17 miles E.S.E. of Koniggratz.—Alfo, a town of Lufatia; 6 miles W. of Gorlitz.

REICHNICH, a town of the duchy of Stiria; 6 miles N.E. of Windiſch Gratz.

REICHOLDSGRUN, a town of Germany, in the principality of Culmbach; 2 miles S. of Kirch Lamitz.

REICHSHOFEN, a town of France, in the department of the Lower Rhine; 9 miles N. of Haguena.

REICHSTHABER, in *Commerce*. See RIX-DOLLAR.

REICHTHAL, in *Geography*, a town of Silefia, in the principality of Breſlau; 32 miles S. of Breſlau. N. lat. $51^{\circ} 9'$. E. long. $17^{\circ} 52'$.

REID, THOMAS, in *Biography*, an eminent divine and moralift, was born at Strachan, in Kincardineſhire, of which pariſh his father was miniſter, in the year 1710. The elements of learning he received at the pariſh ſchool of Kincardine, after which he was ſent to a claſſical ſchool at Aberdeen; and ſo rapid was his progreſs in his ſtudies, that about the age of thirteen he was found fully qualified for the univerſity, and entered as a ſtudent in Mariſchal college. Here he diſtinguiſhed himſelf by his proficiency in the various branches of learning taught during the uſual courſe of four years, particularly in mathematics. At this period he probably took his degree of M.A., and afterwards commenced the ſtudy of theology, and in due time was licenſed as a preacher. He was ſoon appointed librarian to the univerſity, and became intimately acquainted with Mr. John Stewart, the profeſſor of mathematics. This connection ſtrengthened and confirmed his predilection for mathematical ſtudies. Occasionally he read lectures for his friend, in which he diſcovered a happy faculty of making every thing intelligible to the ſtudents, which he clearly apprehended himſelf. In 1736 Mr. Reid reſigned his ſituation of librarian, and accompanied Mr. Stewart on an excursion into England, and became acquainted with many illuſtrious characters in London, at Oxford, and at Cambridge. In the following year, Mr. Reid was preſented by the King's college of Aberdeen to the living of New Machar; but his entrance into the functions of his office was very unpropitious. His unwearied attention, however, to the duties of his office, the mildneſs and forbearance of his temper, and the active ſpirit of his humanity, ſoon overcame all their prejudices; and not many years afterwards, when he was called to a different ſituation, the ſame perſons, who had taken a ſhare in the outrages againſt him, followed him, on his departure, with their prayers and tears.

tears. "We fought," said some of them, "against Mr. Reid, when he came; and would have fought for him, when he went away."

The greater part of his residence at New Machar was devoted to the most intense study; and by way of amusement, he had recourse to gardening and botany, of which he was extremely fond, even in old age. In the year 1748 he published a paper in the Transactions of the Royal Society of London, entitled "An Essay on Quantity, occasioned by reading a Treatise, in which simple and compound Ratios are applied to Virtue and Merit." The treatise here referred to was Dr. Hutcheson's "Inquiry into the Origin of our Ideas of Beauty and Virtue."

The professors of King's college, Aberdeen, in the year 1752, appointed Dr. Reid to be professor of philosophy: the choice originated wholly from the high opinion they were led to entertain of his talents and erudition. It is not known what particular plan he pursued in the course of his lectures; but his department comprehended mathematics, and physics, logic, and ethics. Soon after his removal to this situation, he projected, in conjunction with his friend, Dr. John Gregory, a literary society, which subsisted many years, and which, it is believed, had considerable effect in exciting and directing that spirit of philosophical research, which has since so particularly distinguished the north of Scotland. The writings of Reid, Gregory, Campbell, Beattie, and Gerard, evince the numerous advantages which the members derived from this institution, as they were in the habit of bringing such works as they intended for publication to the test of friendly criticism. Among these the most original was that of our author, published in 1764, entitled "An Inquiry into the Human Mind, on the Principles of Common Sense;" intended to refute the philosophy of Locke and Hartley, by denying the connection which they supposed to subsist between the several phenomena, powers, and operations of the mind; and accounting for the foundation of all human knowledge on a system of instinctive principles. About the time when this "Inquiry" made its appearance, the author received from the college of Aberdeen the degree of doctor of divinity; and by the university of Glasgow he was invited to the professorship of moral philosophy. On the duties attached to this office he entered in 1764; and he was enabled, by means of a handsome income, to concentrate all his attention to his favourite pursuits, which had hitherto been distracted by the miscellaneous nature of his academical engagements. The researches of Dr. Reid concerning the human mind, were extended and methodized in a course, which employed five hours every week, during six months in every year. The substance of these lectures was afterwards given to the world, in a more improved form, in the last of his publications. In the year 1773 appeared, in the form of an appendix to the third volume of Lord Kames' "Sketches of the History of Man," a brief account of Aristotle's logic, with remarks by Dr. Reid. In the year 1781 Dr. Reid withdrew from his public labours, but he was not inactive: his subsequent works afford proof of the assiduity with which he availed himself of his literary leisure. In 1785 he published his "Essays on the Intellectual Powers of Man;" and in 1788, those "On the Active Powers." These volumes complete the system of philosophy, begun in his "Inquiry" many years before.

Notwithstanding his advanced age, Dr. Reid continued to prosecute his studies with unabated ardour and activity. The modern improvements in chemistry attracted his particular notice, and he applied himself with his accustomed diligence to the study of its theories and nomenclature. He

amused himself also, at times, in preparing for a philosophical society, of which he was a member, short essays on particular topics, which happened to interest his curiosity, and on which he thought he might derive or afford useful hints in the course of friendly discussion. His last essay appears to have been written in the 86th year of his age, and was read by the author to his associates but a short time previously to his death. In the month of September 1796, he was seized with a violent disorder, with which he for some time maintained a severe struggle; but which, together with some paralytic attacks, put an end to his useful life on the 7th of October, in the 87th year of his age. In point of bodily constitution, few men have been more indebted to nature than Dr. Reid. His form was vigorous and athletic, and his countenance was strongly expressive of deep and collected thought; but when brightened up by the face of a friend, what chiefly caught the attention was a look of good will and of kindness. The most prominent features of his character were intrepid and inflexible rectitude, a pure and devoted attachment to truth, and an entire command over his passions. In private life, no man ever maintained, more eminently or more uniformly, the dignity of philosophy; combining with the most amiable modesty and gentleness, the noblest spirit of independence. As a public teacher, he was distinguished by unwearied assiduity in inculcating principles, which he conceived to be of essential importance to human happiness. In his elocution and mode of instruction, there was nothing peculiarly attractive. Such, however, were the simplicity and perspicuity of his style; such the gravity and authority of his character, that he was always listened to with profound respect, and, in his latter years, with a veneration, which age added to great wisdom always inspires. Stewart's Life of Reid.

REIDEN, in *Geography*, a town of Switzerland, in the canton of Lucerne; 18 miles N.N.W. of Lucerne.

REJECTIO, a word used by medical authors for the casting any thing up preternaturally by the mouth, whether it be by vomiting or by spitting.

REIFF, in *Geography*. See RIVA.

REIFFERSCHIED, a town of France, in the department of the Sarre, and chief place of a canton, in the district of Prum. The place contains 311, and the canton 3542 inhabitants, in 45 communes. Also, a town of France, in the department of the Rhine and Moselle, capital of a county in the archbishopric of Cologne; 42 miles W. of Coblenz. N. lat. 50° 33'. E. long. 6° 27'.

REIFFLING, a town of the duchy of Stiria, on the river Enns; 28 miles N.W. of Pruck.

REIFFNITZ, a town of Middle Carniola; 4 miles N. W. of Gottschee.

REIFTENBERG, a town of Austria; 59 miles S.E. of Goritz.

REIGELSBERG, a lordship of the duchy of Wurzburg.

REIGNAC, a town of France, in the department of the Gironde; 9 miles N.E. of Blaye.

REIGNIER, a town of France, in the department of the Léman, and chief place of a canton, in the district of Geneva. The place contains 1280, and the canton 9046 inhabitants, on a territory of 102½ kilometres, in 14 communes.

REIGNING WINDS, in *Meteorology*, are those winds which usually prevail in any particular coast or region, the knowledge of which is essentially necessary to every pilot, who is charged with the navigation in those seas.

REIKENES, in *Geography*, a cape on the S. coast of Iceland. N. lat. 63° 43'.

REIKEVIG,

REIKEVIG, a sea-port town of Iceland, consisting of about 60 or 70 houses, standing in two rows of nearly equal length, at right angles to each other, the high street being encumbered with rock. Among the rocks, which on every side surround the town, are scattered wretched hovels, a little raised above the level of the ground. The adjacent country much resembles the summit of some of the highest mountains in Scotland, being composed of fragments of rocks, and presenting only a few patches of alpine vegetation. Almost all the houses of Reikevig are of Norwegian construction, and inhabited by Danes. The women of this town are principally employed in the operation of drying fish. On the little island of Akarve, near this town, are bred eider ducks in great numbers. About six miles to the south of Reikevig is an immense bed of lava, extending a length of 25 miles, and having its black and desolate surface broken into masses and fragments, which render it difficult and dangerous to traverse it, especially where quantities of the "trichostomum" conceal the hollow parts from view. The breadth of this remarkable current varies from two to ten miles; and its hideously shattered aspect is supposed to have resulted from the expansive force of elastic fluids which escaped during the cooling of the lava. Most of the produce of the Icelanders is brought to Reikevig; and the inhabitants of the interior of the country take back, in exchange for their tallow and skins, the dried heads of the cod-fish, and such fish as are injured by the rain and not fit for exportation. These form the principal article of their food, and are eaten raw, with the addition of butter, &c. Bishop Videlinus in this place has a library of 5 or 600 volumes. The author of the work now cited states the height of Hecla at about 5000 feet, and the population of Iceland at about 48,000 persons, who, from the rigour and instability of their climate, can never rely on their native produce even for the necessary articles of subsistence. The principal articles of export are dried fish, (especially cod of a superior quality,) mutton, lamb, beef, butter, tallow, train-oil, coarse woollen cloth, the skins of sheep, lambs and foxes, eider-down and feathers; and their chief importations are timber, fishing tackle, various implements of tin, tobacco, bread, spirituous liquors, salt, linen, &c. A large proportion of their food consists of fish, butter, and various preparations of milk. Hooker's Journal of a Tour in Iceland in 1809.

REILLANE, a town of France, in the department of the Lower Alps; 7 miles S. of Forcalquier.

REIMBURSEMENT, in *Commerce*, the act of repaying or returning what monies a person had received, by way of advance, &c. or what another had disbursed or paid for him. A person who gives a bill of exchange in payment, is to reimburse it, if it come to be protested, for want of being accepted or paid.

REIMBURSING is also used for paying the price a commodity costs its owner.

REIMS, or **RHEIMS**, in *Geography*, one of the most ancient and celebrated cities of France, and principal place of a district, in the department of the Marne, seated on the Velle. Before the revolution this city was the see of an archbishop, who was the first duke and peer of France, and always crowned the king. In this place was the abbey of the Benedictines of St. Remy, the noblest of that order in the kingdom of France; and on the altar of its church, under which St. Remigius was buried, was kept the holy vial, which, as tradition reports, was, in the year 496, at the baptism of Clovis by bishop Remigius, brought from heaven by a dove in deference to the prayer of that saint; the crowd obstructing his passage to the font with the usual

oil. The university of Reims was founded in 1547, and in the following year authorized by the parliament of Paris. This city contains 30,295 inhabitants, in the three parts into which it is divided, and it has three corresponding cantons, the first containing 12,140, the second 10,107, and the third 10,874, in three, four, and five communes respectively, on a territory of 117½ kilometres. Rheims carries on a considerable trade in wine, woollen and silk stuffs, and gingerbread. It has several remains of Roman antiquities, particularly the three gates of the city, which still bear the names of as many Pagan deities, viz. the Sun, Mars, and Ceres. It was taken by the English in the reign of Henry V. N. lat. 49° 15'. E. long. 4° 6'.

REIN, a town of the duchy of Stiria; 9 miles N.W. of Gratz.—Also, a town of the same duchy, on the river Save; 20 miles E. of Cilley.

REIN-Deer, in *Zoology*. See *CERVUS Tarandus*.

REINDORFF, in *Geography*, a town of Bavaria; 4 miles S.S.W. of Bamberg.

REINECCIUS, **REINIER**, in *Biography*, a learned German, who flourished in the 16th century, was a disciple of Melancthon, and taught the belles lettres in the universities of Frankfurt and Helmstadt till his death, in 1595. He is known to the learned world by several works on history and genealogy, in which he was profoundly versed. His chief publications are, "Syntagma de Familiis Monarchiarum trium priorum," 1574; "Familie Regum Judæorum;" "Chronicon Hierosolymitanum;" "Historia Orientalis;" "Historia Julia," three vols. folio; "Methodus Legendi Historiam."

REINECK, in *Geography*, a town of France, in the department of the Rhine and Moselle, late capital of a burgraviate, deriving its name from it, and situated between the duchy of Juliers and electorate of Cologne, on the borders of the Rhine; 14 miles N.N.W. of Coblenz.

REINEN. See **RHEINE**.

REINERTZ, a town of Silesia, in the comté of Glatz, on the borders of Bohemia; famous for its manufactures of beautiful cloth and plush, and excellent paper, equal to the best in Holland; 11 miles W. of Glatz. N. lat. 50° 14'. E. long. 16° 10'.

REINFELDT, a town of Prussia, in the province of Pomerania; 12 miles S.W. of Dantzic.

REINFORCE, in *Gunnery*, is that part of a gun next to the breech, which is made stronger, to resist the force of the powder. There are generally two reinforces in each piece, called the first and second reinforce: the second is somewhat smaller than the first, upon the supposition that when the powder is inflamed and occupies a greater space, its force is diminished, which is very absurd. See **CANNON**.

REINFORCE Rings of a cannon, are flat mouldings like iron hoops, placed at the breech-end of the first and second reinforce, projecting beyond the rest of the metal about one-fourth of an inch. See **CANNON**.

REINFORCEMENT, in *War*, a supply, or new provision of men, arms, ammunition, &c.

REINGUS, in *Geography*, a town of Austria; 12 miles N.N.W. of Waidhoven.

REINHARTSBRUNN, a town of Germany, in the principality of Gotha; 10 miles S.S.W. of Gotha.

REINHARTZ, a town of Saxony; two miles W. of Schmiedelberg.

REINHEIM, a town of the principality of Hesse Darmstadt; 5 miles S.E. of Darmstadt.

REINHOLD, **ERASMUS**, in *Biography*, an eminent German mathematician, was born at Salteldt, in Thuringia, a province in Upper Saxony, in the year 1511. He was educated

educated at the university of Wittemberg, where his genius chiefly inclined him to the study of the mathematics, which he cultivated with great success. He afterwards became a professor of those sciences in the same university, and acquired very high reputation, not only by his lectures, but by the learned and useful writings which he communicated to the public. Of these, which are very numerous, we may mention "*Theoriæ Novæ Planetarum G. Purbachii*," augmented and illustrated with diagrams and scholia. "*Ptolemy's Almagest*, with a Latin Version, and Scholia." In 1551 he published "*Prutenicæ Tabulæ Cælestium Motuum*," which were several times reprinted. In carrying on this work, which cost seven years' labour, he was encouraged by the munificence of Albert, duke of Prussia. They were constructed by him from a comparison of the observations of Copernicus with those of Ptolemy and Hipparchus, and he has fully explained the use of them in a great number of precepts and canons, forming a complete introduction to practical astronomy. Reinhold also made many astronomical observations, but he never had any better instrument than a wooden quadrant. The result of these observations were shewn to Tycho Brahe after the death of Reinhold, who expressed his surprize that so great and meritorious a cultivator of astronomical science was not furnished with better instruments. Reinhold died in 1553, when only in the 42d year of his age, pronouncing the following verse a short time before he expired.

"Vixi, et quem dederas cursum mihi, Christe, peregi."

He had a son of the same name, eminent as a mathematician and physician, who published a small work in the German language "*On Subterranean Geometry*;" also a tract concerning the new star which appeared in Cassiopeia in 1572.

REINISCHDORF, in *Geography*, a town of Silesia, in the principality of Neisse; 5 miles N. of Neisse.

REINS, in *Anatomy*, the kidneys. See KIDNEY and RENES.

The word, according to Varro, is formed from the Greek, *ῥεῖν*, *quasi rivi obsecni humoris ab iis oriantur*.—The Greeks call the rein *ῥεῖπος*, from the verb *ῥεῖν*, to rain, snow, &c.

In the manege they say, a horse should have *double reins*; that is, he should have them a little more elevated on each side of the back-bone, than upon it; so that, passing your hand along it, you find it large, well-furnished, and double, by the hollow that goes all along the back-bone. The back should be firm and not hollow, or bending from the withers to the croup, but straight.

REINS, of a bridle, also denote two straps of leather meeting in the bridle-hand of the horseman, in order to make the bit bear, and keep the horse under subjection. See BRIDLE.

It is also a name given by the duke of Newcastle to two straps or ropes of a cavesson, which he ordered to be made fast to the girths, or the pommel of the saddle, with intent that the rider should pull them with his hand, in order to bend and supple the neck of the horse.

REIN, *Falſe*, is a lath of leather, passed sometimes through the banquet, to bend the horse's neck, which is disapproved of by the duke of Newcastle, because it flacks the curb, and makes the bit no more than a trench that has no curb.

REINS, in *Rural Economy*, the long thongs or strips of leather, or other materials, by which horses or other animals are directed in carriages or teams. These reins are much used in some counties, as Norfolk and Suffolk, in directing the plough-teams, in order to save the expence of another

person, the ploughman directing them in this way himself, the driver being by this means dispensed with.

REINS, *Check*, a term signifying the same thing as a sort of rein, and which is made use of in particular districts, in checking and directing the animals.

REINS, *Whip*, a term used to signify a sort of hempen rein, employed for directing the team in ploughing in some districts, so called in consequence of being used instead of whips.

REINS of a Vault. See VAULT.

REINSBERG, or RHINSBERG, in *Geography*, a town of Brandenburg, in the Middle Mark; 10 miles N.N.E. of New Ruppin. N. lat. 53° 4'. E. long. 12° 58'.

REINSCHNICK, DER, a mountain of Stiria; 12 miles S.E. of Landsperg.

REINSDORF, a town of Saxony, in the circle of Erzgebirg; two miles E.S.E. of Zwickau.

REINSPURG, a town of Bavaria, in the territory of Rothenburg; six miles S.S.W. of Rothenburg.

REINSTATING, the restoring of a person or thing to its former state or condition, from whence it had been disturbed or displaced. See REHABILITATION.

REINSTEIN, in *Geography*. See REGENSTEIN.

REINSURANCE, or RE-ASSURANCE, in *Commerce*, a contract by which a first insurer relieves himself from the risks which he has undertaken, and devolves them upon other under-writers, called re-insurers, or re-assurers. When a policy of insurance has been once signed, the under-writers are bound by the terms of it; nor can they be released from their contract without the consent of the insured. But if an under-writer repent of what he has done; if he be afraid to encounter the risk which he has engaged to run; or if he find that he has incautiously engaged himself to a greater amount than he may be able to discharge, he may shift it, or part of it, from himself to other insurers, by causing a re-insurance to be made on the same risk, upon the best terms in his power, and the new insurers will be responsible to him in case of loss, to the amount of the re-insurance. But in such case, the new insurers are responsible to the original under-writer only, and not to the original insured, who can have no remedy against him, in case of loss, even though the original insurer become insolvent; because there is no privity of contract between the original insured and the re-insurer. If, therefore, the original insurer fail, so that the original insured receive only a dividend, however small, the re-insurer can gain nothing by this, but must pay the full amount of the loss to the original insurer. Such is the law on this subject, in most of the commercial states of Europe. But in this country it was found, about the time when the statute 19 Geo. II. c. 17. was made, that this mode of insurance, though perfectly reasonable, when confined to its proper object, had been perverted from its original use, and was employed as a mode of speculating in the rise and fall of premiums; and the legislature foreseeing that it might be used as a colour for wager policies, and a means of evading the provisions of that act, declares (sect. 4.) "that it shall not be lawful to make re-insurance, unless the insurer shall be insolvent, become bankrupt, or die; in either of which cases, such insurer, his executors, administrators or assigns, may make re-insurance to the amount of the sum before by him insured; provided it be expressed in the policy to be a re-insurance." This clause, having no words to confine its operation to ships belonging to British subjects, like the first clause of the act restraining insurances, *interest or no interest*, extends to re-insurances made in England in foreign ships, even when they are insured abroad. This has been determined; though it is observable that the following case, in which

which that question was made, was not the species of re-insurance above described, and to which only the statute refers, but a *second insurance*, effected on account of the *original insured*.

That was the case of an insurance made in London, on a French vessel, which had before been insured at Marseilles for the same sum, by an insurer there, who, at the time of subscribing the second policy, was living and solvent, and who, in fact, afterwards paid the sum insured by him. Upon this case the court determined that the latter policy was void by the words of the act; for though the first clause of the act which prohibits insurances, 'interest or no interest,' is confined to insurances on British ships, yet the fourth section being general, and without any such restrictive clause, every re-insurance in this country, either by British subjects, or foreigners, on British or foreign ships, is declared void by the statute, unless the first insurer be insolvent, become bankrupt, or die.

There are two other kinds of re-insurance; the one where the insured insures the solvency of the insurers; the other, where he makes a new insurance, in consequence of the insolvency of an insurer during the continuance of the risk.

The insurance of the solvency of an insurer is permitted and practised in some foreign countries; but it seems never to have been in use among us; not, perhaps, as has been supposed, because the solvency of an under-writer is not an insurable interest, or that such an insurance would be deemed a wager; but, more probably, because the insolvency of an insurer seldom happens in England; besides, a *double insurance* would better answer the end proposed.

If France, if an insurer fail during the continuance of the risk, the insured may insist on the dissolution of the contract, unless the creditors of the insolvent insurer, in order to entitle themselves to receive the premium, (which is rarely paid in that country till after the risk is ended,) will give security for the payment of the sum insured, in case of loss. At Marseilles, (for in France different practices prevail in different provinces,) the insured, in such case, sues the insolvent insurer, till he obtains a sentence, authorizing him to re-insure at the expence of the insolvent, which he may deduct from the stipulated premium, if it be not paid, and if this be insufficient, then out of the effects of the insolvent.

Double insurance is where the insured makes two insurances on the same risk, and the same interest; and it differs from a re-insurance in this, that it is made by the *insured*, in order that he may be entitled to receive a double satisfaction, in case of loss; whereas, a re-insurance is made by a former insurer, his executors or assigns, to protect himself and his estate from a risk to which they were liable by the first insurance. A re-insurance, except in the cases permitted by the stat. 19 Geo. II. c. 37. § 4, is absolutely void; but a double insurance, though it be made with a view to a double satisfaction in case of loss, and is therefore in the nature of a wager, is not void by the law of England. The two policies are considered as making but *one insurance*. They are good to the extent of the value of the effects put in risk: but the insured shall not be permitted to recover a double satisfaction. He may sue the under-writers on both the policies, but he can only recover the real amount of his loss, to which all the under-writers shall contribute in proportion to their several subscriptions. And therefore, if he should content himself with suing only on one of the policies, the under-writers on that policy may recover a rateable contribution from those on the other.

In consequence of the determination of lord Mansfield, in 1763, it has been agreed to be the course of practice, that,
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upon a double insurance, though the insured is not entitled to two satisfactions, yet, that in an action upon the first policy, he may recover the whole sum insured, and may leave the defendants therein to recover a rateable satisfaction from the other insurers. Formerly, in the case of an *over-insurance*, that is, where, in a single policy, the sums subscribed amount to much more than the value of the effects insured, the first under-writers on the policy were holden to be answerable to the extent of the loss, and the subsequent ones discharged. Although only a single satisfaction can be recovered on a double insurance by the same person, yet different persons may insure the same thing, and each recover the full value of the thing insured. To enable the defendant, in an action on a policy, to discover whether there be a double insurance, he may, by the authority of the statute 19 Geo. II. c. 37. § 6, call upon the plaintiff to declare in writing, what sums he has insured in the whole, and how much he has borrowed on bottomry or respondentia. Marshall's Treatise on the Law of Insurance, vol. i. ch. 4. § 4.

REINTAL, in *Geography*, a town of Austria; four miles E.S.E. of Feldsberg.

REINTEGRATION. See REDINTEGRATION.

REJOICING FIRE, in *Military Affairs*, is used on obtaining a victory, or in celebrating some public festival: of this there are two sorts, viz. one by a volley, and the other by a running fire, from the right to the left of the battalion or line.

REJOINDER, in *Law*, the defendant's answer to the plaintiff's replication.

The order of the court of chancery is thus; first, the defendant puts in an answer or plea to the plaintiff's bill, which is sometimes also called an *exception*; the plaintiff's answer to this is called a *replication*; and the defendant's answer to that, a *rejoinder*.

The plaintiff may answer the rejoinder by a *sur-rejoinder*, upon which the defendant may *rebut*; and the plaintiff may answer him by a *sur-rebutter*; which pleas, replications, rejoinders, sur-rejoinders, rebutters, and sur-rebutters, answer to the *exceptio, duplicatio, triplicatio*, and *quadruplicatio* of the Roman laws. See PLEADING.

REJOINTING, or REJOYNTING, in *Architecture*, the filling up of joints of the stones in old buildings, &c. when worn hollow by the course of time, or by weather.

Rejointing is to be performed with the best mortar, as that of lime and cement; sometimes also with plaster; as in the joints of vaults, &c.

REIPOLTZHEIM, in *Geography*, a town of the duchy of Wurzburg; three miles N.E. of Schwarzbach.

REIPOLTZKIRCHEN, a castle of France, in the department of Mont Tonnerre, which gave name to a lordship, situated in the Hunrück; five miles E. of Lautereck.

REIS, RE, or *Res*, in *Commerce*. See REES.

REISBACH, in *Geography*, a town of Lower Bavaria, in the Vils; 35 miles W. of Passau.

REISCH, a town of Moravia, in the circle of Iglau; 18 miles S. of Iglau.

REISCHSTADT, a town of Bohemia, in the circle of Boleslau; two miles N.W. of Nimes.

REIS-EFFENDI, in the *Turkish Empire*, one of the ten members of the *divan*, (which see,) or council of the grand visir, of which the visir and musti are the presidents. The reis-effendi is a kind of secretary of state, high chancellor of the empire, and minister for foreign affairs. He signs all the orders of the Porte, which do not directly concern the finances and the military operations; he treats with all the European ministers who are at Constantinople: in a word, every thing that concerns the foreign powers, and

every thing that relates to the interior administration, pass through the channel of the reis-essendi; but he does nothing without communicating it to the grand visir, and taking his orders. In this council there are also two *ex-reis-essendi*.

REISENBERG, in *Geography*, a town of Aultria, on the Reifenspach river; 12 miles S.E. of Vienna.

REISENBURG, a town of Prussia, in the province of Oberland, built in the year 1169, and anciently the residence of the bishops of Pomerania. The chief subsistence of the inhabitants is derived from brewing and agriculture; near it is an ancient castle; 78 miles S.W. of Konigsberg.

REISENGEBERG, a town of Bohemia, in the circle of Koniggratz. N. lat. 50° 40'. E. long. 15° 30'.

REISENPACH, a river of Aultria, which runs into the Danube; 12 miles below Vienna.

REISHOFFEN, a town of France, in the department of the Lower Rhine; 21 miles N. of Strasburg.

REISJARVI, a town of Sweden, in the government of Ulea; 47 miles E. of Gamla Karleby.

REISKE, JOHN JAMES, in *Biography*, a learned philologist, born in 1716, at Zorlis, in Misnia, was the son of a tanner in that place. He was, at the age of twelve, sent to the orphan-school at Halle, where he made a rapid progress in the study of the place. In 1733 he entered at the university of Leipzig, and being destined for the theological profession, he spent five years chiefly in the study of rabbinical writings, and in the study of the Arabic language. To the latter he became so ardently attached, and his passion for Arabic books was so strong, that he almost deprived himself of necessaries to purchase them. He went to Holland with the view of improving himself in his favourite language, and while there, he ransacked all the Oriental treasures of the library at Leyden, while, for his subsistence, he was obliged to become a corrector of the press. He passed his time in a state of indigence that brought upon him hypochondriac affections, the effects of which never left him. During his residence at Leyden, he was presented with a gratuitous degree in physic, but he never intended to avail himself of it in the way of practice: "Poverty," says his biographer, "was his perpetual companion, and his scanty resources were derived from correcting the press, translating, and performing other tasks for booksellers." Many learned pieces in Oriental and Greek literature occasionally proceeded from his pen, which made him well known in the learned world: and several of the works edited by him are held in very high estimation. He was at last nominated rector of the college of St. Nicholas, in Leipzig, a situation which enabled him to pursue his literary labours more according to his inclination. At the age of forty-eight he married Ernestine Muller, a young woman of twenty-five, who, under his instructions, acquired so much knowledge of the Greek and Latin, and some modern languages, that she became extremely useful to her husband in his editorial employments. He died at the age of fifty-eight, in the year 1774. Of the most valuable works of Reiske, are "Dissertatio de Principibus Muhamedanis qui aut ab Eruditione aut ab Amore Literarum incluserunt;" "Animadversiones in Sophoclem;" "Animadversiones in Auctores Græcos;" "Oratorum Græcorum," 8 vols.; "Plutarchi Opera omnia;" "Maximi Tyrii Dissert.;" "Apparatus Critici ad Demosthenem," 3 vols. And after his death were published his "Conjectura in Jobum et Proverbia Salomonis, cum Oratione de Studio Arabice Linguae." The "Acta Eruditiorum" were much indebted to the pen of Reiske.

REISNITZ, in *Geography*, a town of the duchy of Carniola; four miles N.W. of Gottschee.

REISSENDORF, a town of Silesia, in the principality of Neisse; four miles N. of Patshkau.

REISTEN, a town of the duchy of Wurzburg; six miles N.N.E. of Arnstein.

REISTERSTOWN, a post-town of America, in Baltimore county, Maryland; ten miles S.E. of Westminster.

REITERATED GRAFTING. See GRAFTING.

REITERATING, in *Printing*. See PRINTING.

REITERATION, the act of repeating a thing, or doing it a second time.

The church does not allow of the reiteration of baptism. St. Gregory observes, that it is no reiteration when there are wanting proofs of the thing's having been regularly done before.

REITLENGIN, in *Geography*. See REUTLENGIN.

REITTERECK, a town of Stiria; seven miles E. of Voitsburg.

REITTERS, an ancient title given the German cavalry. The word is originally High Dutch, and signifies a horseman, cavalier, or even knight.

REITZ, in *Geography*, a town of Portugal, in the province of Beira; three miles N. of Viseu.

REKEK, a small island in the East Indian sea. S. lat. 1° 33'. E. long. 128° 40'.

RELAIS, in *Fortification*, a French term, the same with *berme*.

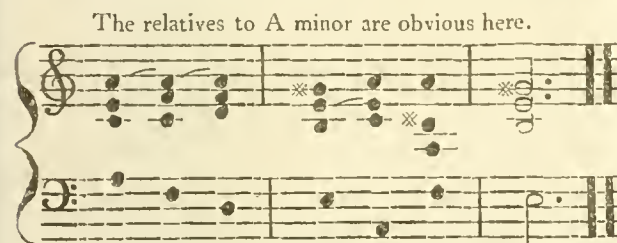
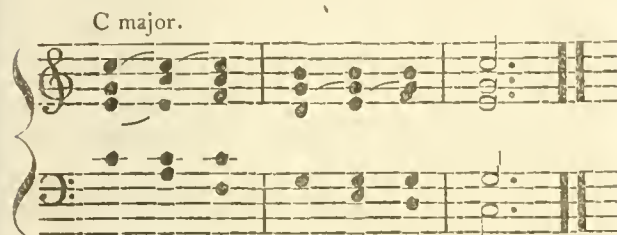
RELAND, ADRIAN, in *Biography*, an eminent orientalist and polite scholar, was born in the year 1676, at a village in North Holland. He was educated at Amsterdam, and made such progress in learning, that, having gone through the usual classical course when he was only eleven years old, he employed the next three years in making himself acquainted with the Hebrew, Syriac, Chaldean, and Arabic languages. At the age of fourteen he was sent to the university at Utrecht, and in three years was admitted to the degree of doctor in philosophy, and on this occasion he sustained a thesis "De Libertate Philosophandi." After a residence of six years at Utrecht he removed to Leyden, and was in a short time chosen by the earl of Portland as preceptor to his son. At the age of twenty-four, the university of Harderwyk nominated him to the chair of philosophy, but he did not remain long in that situation, for the university of Utrecht, on the recommendation of king William, invited him to the professorship of the Oriental languages and Jewish antiquities, which he accepted, and occupied with high reputation during the remainder of his life. He died at the age of 43, in the year 1719. Few writers have met with more general applause than Reland. His principal works, which are all extremely valuable, are; 1. "Pælestina Monumentis veteribus illustrata," 2 vols. 4to. 2. "Dissertationes de nummis veterum Hebræorum." 3. "Antiquitates sacræ veterum Hebræorum." 4. "Introductio ad Grammaticam Hebræam." 5. "De Spoliis Templi Hierosolymitani in Arcu Titiano Romæ conspicuis." 6. "De Religione Muhamedica." Besides these he published many other things. In private life he was distinguished by his modesty, humanity, and learning, and carried on a correspondence with the most eminent scholars of his time. Moreri.

RELAPSE, in *Medicine*, the recurrence of a disease during the period of convalescence.

Relapses of all diseases, whether acute or chronic, are deemed more dangerous than the original attack; because the constitution, being already debilitated and reduced by the previous illness, is less capable of resisting the farther ravages of disease. This may be said to be true of all acute diseases,

diseases, such as fevers, dysenteries, inflammations of the lungs, liver, &c. Nevertheless, relapses of these disorders are not always fatal; because, as the weaker constitution is less capable of being excited to violent action, so these second attacks are sometimes milder, and more easily influenced by remedies. Relapses of chronic diseases, such as dropsies or jaundice, are more unfavourable; because their recurrence implies that the internal disease, from which they originate, is not removed, but has only been temporarily alleviated.

RELATIO, Lat., *Relation*, Engl., in *Musik*. Relative sounds are in general such as belong to two or more chords, as in the key of C. The chords of A, F, G, and E, are relative chords; as E, the 5th of A, is 3d of C: in the chord of F, C is the 5th; in the chords of G and E, each of those sounds is a part of the chord of C.



In the modulation by rising and falling a 3d in the base, two relative notes are in common with each chord. The most agreeable relation of a minor key to a major, is in the modulation from a minor key to the 3d above: as from A to C, or D to F; the scales of both keys being the same in descending. But falling a 3d in the base from a minor 3d to a major, as from A to F, or from D to Bb, is still more pleasing.

False relation is C* against C#, or G* in the chord of C#. But even these false relations are allowed now, as *passing-notes* of taste, though not in the body of the harmony.

RELATION, **RELATIO**, in *Philosophy*, the mutual respect of two things; or what each is with regard to the other.

The word is formed a *referendo*: relation consisting in this, that one thing is referred to another: whence it is also called *respect*, *habitude*, and *comparison*.

The idea of relation we acquire, when the mind so considers any thing, that it doth, as it were, bring it to, and set it by, another, and carry its view from the one to the other. Hence the denominations given to things intimating this respect, are called *relatives*; and the things so brought together, are said to be *related*.

Thus, when I call Caius *husband*, or this wall *whiter*, I intimate some other person or thing in both cases, with which I compare *him* or *it*. Hence the wall is called by the schoolmen the *subject*; the thing it exceeds in whiteness, the *term*; and the whiteness, the *foundation* of the relation.

Relation may be considered two ways; either on the part of the mind referring one thing to another; in which sense relation is only a mode or affection of the mind, by which we make such comparison; or on the part of the things referred, which being no other than ideas, relation, in this sense, is only a new idea resulting or arising in the mind upon considering of two other ideas. So that relation, take it as you will, is only in the mind, and has nothing to do with the things themselves.

Any of our ideas, Mr. Locke observes, may be the foundation of relation. Though where languages have failed to give correlative names, the relation is not easily taken notice of; as in concubine, which is a relative name, as well as wife.

There is, in effect, no idea but is capable of an infinite number of relations: thus, one single man may at once sustain the relations of father, brother, son, husband, friend, subject, general, European, Englishman, islander, master, servant, bigger, less, &c. to an almost infinite number; he being capable of as many relations as there can be occasions of comparing him to other things in any manner of agreement or disagreement, or any respect whatsoever.

The ideas of relations are much clearer and more distinct than those of the things related; because the knowledge of one simple idea is oftentimes sufficient to give the notion of a relation; but, to the knowing of any substantial being, an accurate connection of several ideas is necessary.

The perception we have of the relations between the various ideas in which the mind acquiesces, makes what we call *judgment*. Thus, when I judge that twice 2 make 4, or do not make 5, I only perceive the equality between twice 2 and 4, and the inequality between twice 2 and 5.

The perception we have of the relations between the relations of various things, constitutes what we call *reasoning*. Thus, when from this that 4 is a smaller number than 6, and that twice 2 is equal to 4, I gather, that twice 2 is a less number than 6; I only perceive together the relation of the numbers twice 2 and 4, and the relation of 4 and 6.

The ideas of cause and effect, we get from our observation of the vicissitude of things, while we perceive some qualities or substances begin to exist, and that they receive their existence from the due application and operation of other beings. That which produceth, is the cause; that which is produced, is the effect.

Thus, fluidity in wax is the effect of a certain degree of heat, which we observe to be constantly produced by the application of such heat.

The denominations of things taken from time are, for the most part, only relations. Thus, when it is said, that queen Elizabeth lived sixty-nine, and reigned forty-five years, no more is meant, than that the duration of her existence is equal to sixty-nine, and of her government to forty-five, annual revolutions of the sun; and so are all words answering to how long.

Young and old, and other words of time, that are thought to stand for positive ideas, are indeed relative, and intimate a relation to a certain length of duration, of which we have the ideas in our minds. Thus, we call a man young or old, that had lived little or much of that time which men usually attain to: and thus a man is called young at twenty, but a horse old at the same period.

There are other ideas that are truly relative, which we signify by names that are thought positive and absolute; such as great and little, strong and weak. The things thus denominated

minated are referred to some standards, with which we compare them: thus, we call an apple *great*, which is bigger than the ordinary sort of those we have been used to; and a man *weak*, that has not so much strength or power to move as men usually have, or as others of his own size have.

Authors give various divisions of relations. The school philosophers commonly divide them into those of *origination*, under which are comprehended the relations of cause and effect; those of *negation*, which are between opposite things; and those of *affirmation*, which are relations of agreement between whole and part, the sign and thing signified, the adjunct and subject. This division is founded upon this, that the mind can only compare things three ways; *viz.* by inferring, denying, and affirming.

Others divide relations into those of *origination*; those of *agreement*, *e. gr.* similitude, parity, &c.; those of *diversity*; and those of *orders*, as priority, posteriority, &c.

Others divide them into *predicamental* and *transcendental*. Under the first come those relations between things that belong to the same predicament, *e. gr.* between father and son. To the latter belong those which are more general than the predicaments, or are of different predicaments; as the relations of substance and accident; of cause and effect; and of Creator and creature.

Mr. Locke gives us a distribution of relations on a different principle. All simple ideas, he observes, in which are parts or degrees, afford an occasion of comparing the subjects in which they are to one another, in respect of those simple ideas; as whiter, sweeter, more, less, &c. These, depending on the equality and excess of the same simple idea, in several subjects, may be called *proportional* relations.

Another occasion of comparing things being taken from the circumstances of their origin, as father, son, brother, &c. these may be called *natural* relations.

Sometimes the foundation of considering things is some act, by which any one comes by a moral right, power, or obligation, to do something: such are general, captain, burgher: these are *instituted* and *voluntary* relations, and may be distinguished from the natural, in that they are alterable and separable from the persons to whom they sometimes belonged, though neither of the substances so related be destroyed. But natural relations are not alterable, but are as lasting as their subjects.

Another relation is the conformity or disagreement of men's voluntary actions to a rule, to which they are referred, and by which they are judged of: these may be called *moral* relations.

It is this conformity or disagreement of our actions to some law (by which good or evil is drawn on us from the will and power of the law-maker, and is what we call *reward* or *punishment*) that renders our actions morally good or evil.

Of these moral rules or laws there seem to be three sorts, with their different enforcements. First, the divine law; secondly, civil law; thirdly, the law of opinion or reputation. By their relation to the first, our actions are either sins or duties; to the second, criminal or innocent; to the third, virtues or vices. Locke's Essay, vol. i. chap. 25, 26, 33.

RELATION, in *Logic*, is an accident of substance, accounted one of the ten categories or predicaments.

Each substance admits of an infinity of relations. Thus the same Peter considered with regard to Henry, is in the relation of a master; with regard to John, in that of a tenant; with regard to Mary, in that of a husband, &c.

Again, with regard to one person, he is rich; with regard to another, poor; with regard to another, he is far, near, tall, short, a neighbour, stranger, learned, unlearned, good, bad, equal, &c. It is disputed among the school philosophers, whether or no the relation be a thing formally and really distinct from the foundation of the substance.

RELATION, *Relatio*, in *Rhetoric*, is sometimes used to signify the same with *recrimination*; which see.

RELATION is also used, in the *School Theology*, to denote certain of the divine perfections, called *personal* ones; because by these one Divine Person is referred to another, and distinguished from it.

Hence the schoolmen teach, that in God there is one nature, two processions, three persons, and four relations.

These relations are paternity, filiation, active spiration, and passive spiration.

RELATION, in *Geometry*, *Arithmetic*, &c. is the habitude, or respect of two quantities to one another, with regard to their magnitude. This we more usually call *ratio* or *reason*. See RATIO.

The equality or sameness of two such relations we call *proportion*; which see.

RELATION, in *Grammar*, is the correspondence which words have to one another in *construction*; which see. See also REGIMEN and SYNTAX.

Faulty and irregular relations are the things chiefly to be guarded against in writing correctly; they make the sense obscure, and frequently equivocal. Thus: the orator was attended to with a coldness, which was the more remarkable, as the audience were under some emotion before he began. Here coldness being put indeterminately, the relative *which* can have no just and regular relation to it.

RELATION is also frequently used for analogy, or what several things have in common. See ANALOGY.

In painting, architecture, &c. a certain relation of the several parts and members of the building, or picture, constitutes what we call *symmetry*; which see.

RELATION, in *Law*, is where two things, as times, &c. are considered as if they were one; the thing subsequent being considered as taking effect, by relation, at the time preceding.

As if A deliver a writing to B, to be delivered to C, as the deed of A; the writing shall be deemed to be delivered to C, at the time when it was given to B, by relation.

When the execution of a thing is done, it hath relation to the thing executory, and makes all but one act to record, although performed at several times. (1 Rep. 199.) Judgment shall have relation to the first day of the term, as if given on that very day, unless there is a memorandum to the contrary; as where there is a continuance till another day in the same term. (3 Salk. 212.) A verdict was given in a cause for a plaintiff, and there was a motion in arrest of judgment within four days; the court took time to advise, and in four days afterwards the plaintiff died: it was adjudged, that the favour of the court shall not prejudice the party, for the judgment ought to have been given after the first four days; and though it is given after the death of the party, it shall have relation to the time when it ought to have been given. (1 Leon. 187.) Rule was had for judgment, and two days after the plaintiff died; yet the judgment was entered, because it shall have relation to the day when the rule was given, which was when the plaintiff was alive. (Poph. 132.) Judgment against an heir of the obligation of his ancestor shall have relation to the time of the writ *first* purchased; and from that time it will

will avoid all alienation made by the heir. (Cro. Car. 102.) If one be bail for a defendant, and before judgment he leaves his lands; they shall be liable to the bail, and judgment by relation.

By stat. 29 Car. II. c. 3. § 16. writs of execution shall bind the property of goods taken in execution, only from the time of their delivery to the officer. Sale of goods of a bankrupt, by commissioners, shall have relation to the first act of bankruptcy; and be good, notwithstanding the bankrupt sells them afterwards. (Stat. Jac. I. c. 15.) If a man buys cattle in a market, which are stolen, and selleth them out of the market, though the cattle are afterwards brought into the market, and the second bargain confirmed, and money paid, &c., this bargain will not be good; for it shall have relation to the beginning, which was unlawful. (Dyer 99.) Fines, being but common assurances, shall be guided by the indentures precedent; and the execution of them have relation to the original act. (Cro. Jac. 110.) Letters of administration relate to the death of the intestate, and not to the time when they were granted.

So bills in parliament to which the king assents on the last day of parliament, shall relate and be of force from the first day thereof. Coke calls this *fidio juris*.

RELATION, in *Musick*. See RELATIO.

RELATIVE PROPOSITIONS, are such as include some relation and comparison.

Thus, where the treasure is, there will the heart be; As much as thou hast, so much thou art worth, &c. are relative propositions.

RELATIVE gravity, levity, motion, necessity, place, space, time, velocity. See the several substantives.

RELATIVE Terms, in *Logic*, are words which imply a relation, or a thing considered as compared to another.

Relative terms include a kind of opposition between them; yet so, as that the one cannot be without the other.

Such are *father and son, husband and wife, king and subjects*, &c.

RELATIVE, in *Grammar*, is a word or term, which in the construction answers to some word foregoing, called the *antecedent*; which see.

All relatives are said to reciprocate, or mutually infer each other; and, therefore, they are often expressed by the genitive case.

RELATIVE Pronoun. See PRONOUN.

RELATOR, in *Law*, a rehearer, or teller, applied to an informer. See INFORMATION.

RELAXATION, in *Law*, is used for a *releasing*. See RELEASE.

In this sense, we say the relaxation of an attachment in the court of admiralty.

The tenor of indulgence is a relaxation, or a diminution, of the pains of purgatory.

RELAXATION, in *Surgery*, is a preternatural extension, or straining of a nerve, tendon, muscle, or the like; either through violence or weakness.

Hernias are descents or relaxations of the intestines, &c.

From the same cause arise descents or prolapsions of the anus, &c.

RELAY, a fresh equipage, horse, &c. sent before, or appointed to be ready, for a traveller to change, to make the greater expedition; as in riding post.

The term is borrowed from the French, *relais*, which signifies the same thing. In France, the general of the posts entitles himself superintendent of the relays.

RELAY Horses, in the *Artillery*, are horses that march

with the artillery or baggage, and are ready to relieve others, or to assist in going up a hill, or through bad roads, &c.

RELAYS, in *Hunting*, are fresh sets of dogs, or horses, or both, disposed here and there for readiness, in case the game come that way, to be cast off, or to mount the hunters in lieu of the former, which are supposed to want respite.

RELAY, in *Tapestry*, is an opening left in a piece of tapeltry, where the colours or figures are to be changed; because on those occasions, the workmen are changed; or else the places are left to be filled up, till the rest of the work is done. See TAPESTRY.

RELEASE, RELAXATIO, in *Law*, denotes an instrument, by which estates, rights, titles, entries, actions, and other things, are sometimes extinguished and annulled, sometimes transferred, sometimes abridged, and even sometimes enlarged: and it is a species of conveyance which presupposes some other conveyance precedent, and serves to enlarge, confirm, alter, restrain, restore, or transfer the interest granted by such original conveyance.

A release is either in fact or in law. A release *in fact*, is that which the very words do expressly declare.

A release *in law*, is that which acquits by way of consequence, or intendment of law. A release is the giving or discharging of a right of action, which a man hath claimed, or may claim, against another, or that which is his: or it is the conveyance of a man's interest or right which he hath to a thing, to another who hath possession of it, or some estate in it. (4 New Abr.) According to Coke releases are distinguished into express releases in deed, and those arising by operation of law; and are made of lands and tenements, goods and chattels; or of actions real, personal and mixed. (1 Inst. 264.) Releases of land may enure, or take effect, either, 1. By way of *enlarging an estate, or enlarger l'estate*: as if there be tenant for life or years, remainder to another in fee, and he in remainder releases all his right to the particular tenant and his heirs, this gives him the estate in fee. (Litt. § 465.) But in this case the releasee must be in possession of some estate, for the release to work upon: for if there be a lessee for years, and, before he enters and is in possession, the lessor releases to him all his rights in the reversion, such release is void for want of possession in the releasee. (Litt. § 459.) But when it is said, that a release, which enures by enlargement, cannot work without a possession, it must be understood to mean, not that an actual estate in possession is necessary, but that a "vested interest" suffices for such a release to operate upon. By comparing this with the operation of a LEASE and Release (which see) it will be seen, that not only estates in possession, but estates in remainder and reversion, and all other incorporeal hereditaments, may be effectually granted and conveyed by lease and release; but it is an inaccuracy to say, that the releasees are, in these cases, in actual possession of the hereditaments: the right expression is, that they are actually vested in him, by virtue of the lease in possession and the statute. 1 Inst. 270. (a) n. 3.

To make releases operate by enlargement, it is generally necessary, that the releasee, at the time the release is made, should be in actual possession of, or have a vested interest in, the lands intended to be released; that there should be a privity between him and the releasor; and that the possession of the releasee should be notorious.

2. By way of *passing an estate, or mitter l'estate*: as when one or two co-parceners release all their right to the other, this passeth the fee-simple of the whole. (1 Inst.

(1 Inst. 273.) And in both these cases there must be a privity of estate between the releasor and the releasee; that is, one of their estates must be so related to the other, as to make but one and the same estate in law.

3. By way of *passing a right*, or *mitter le droit*: as if a man be disseised, and releaseth to his disseisor all his right; hereby the disseisor acquires a new right, which changes the quality of his estates, and renders that lawful which before was tortious or wrongful. (Litt. §. 466.)

4. By way of *extinguishment*: as if my tenant for life makes a lease to A for life, remainder to B and his heirs, and I release to A; this extinguishes my right to the reversion, and shall enure to the advantage of B's remainder as well as of A's particular estate. (Litt. §. 470.)

5. By way of *entry and feoffment*: as if there be two joint disseisors, and the disseisee releases to one of them, he shall be sole seised; and shall keep out his former companion; which is the same in effect as if the disseisee had entered, and by that means put an end to the disseisin, and afterwards had enfeoffed one of the disseisors in fee. (1 Inst. 278.) And hereupon we may observe, that when a man has in himself the possession of lands, he must at the common law convey the freehold by feoffment and livery; which makes a notoriety in the country: but if a man has only a right or a future interest, he may convey that right or interest by a mere release to him that is in possession of the land: for the occupancy of the releasee is a matter of sufficient notoriety already. Blackst. Com. book ii. See *LEASE and Release*.

Littleton says, that the proper words of a release are "remissione, relaxasse, and quietum clamasse," which have all the same signification. Lord Coke adds, "renunciare, acquietare," and says, that there are other words which will amount to a release; as, if the lessor grants to the lessee for life, that he shall be discharged of the rent; this is a good release. (Litt. §. 445. 1 Inst. 264. Plowd. 140.) So a pardon, by act of parliament, of all debts and judgments, amounts to a release of the debt: the word pardon including a release. (1 Sid. 261.) An express release must regularly be in writing and by deed, according to the common rule, "eodem modo oritur, eodem modo dissolvitur," so that a duty arising by record must be discharged by matter of as high a nature: so of a bond or other deed. (Co. Litt. 264. b. 1 Rol. Rep. 43. 2 Leon. 76. 213. 2 Rol. Abr. 408. 2 Sand. 49. Morr. 573. pl. 787.) But a promise by words may, before breach, be discharged or released, by word of mouth only. (1 Sid. 177. 2 Sid. 78. Cro. Jac. 483. 620. See Cro. Car. 383. 1 Mod. 262. 2 Mod. 259. 1 Sid. 293.) A release of a right in chattels cannot be without deed. (1 Leon. 283.) A covenant perpetual, as that the covenantor will not sue beyond a certain limitation of time, is an absolute release. But if the covenant be, that he will not sue *till* such a time, this does not amount to a release, nor is pleadable in bar as such, but the party hath remedy only on his covenant. If two are jointly and severally bound in an obligation, and the obligee, by deed, covenants and agrees not to sue one of them; this is no release, and he may notwithstanding sue the other. (Cro. Car. 551. 2 Salk. 575.) But if two are jointly and severally bound, a release to one discharges the other. L. Raym. 420.

It seems agreed, that a will, though sealed and delivered, cannot amount to a release; and, therefore, where in debt on an obligation, by the representative of a testator, a defendant pleaded, that the testator by his last will in writing released to the defendant; this was adjudged ill, and that no advantage could be taken by plea. (1 Sid. 421.) But it hath been held in equity, that though a will cannot enure

as a release, yet provided it were expressed to be the intention of the testator that the debt should be discharged, the will would operate accordingly; and that, in such case, it would be plainly an absolute discharge of the debt, though the testator had survived the legatee. (1 P. Wms. 85. 2 Vern. 521.) If a debt is mentioned to be devised to the debtor, without words of release, or discharge of the debt, and the debtor die before the testator, this will not operate as a release, but will be considered as a lapsed legacy, and the debt will subsist. (2 Vern. 522.) A debt is only a right to recover the amount of the debt by way of action; and as an executor cannot maintain an action against himself, or against a co-executor, the testator, by appointing the debtor an executor of his will, discharges the action, and consequently discharges the debt. Still, however, when the creditor makes the debtor his executor, it is to be considered merely as a specific bequest or legacy, devised to the debtor to pay the debt; and, therefore, like other legacies, it is not to be paid or retained till the debts are satisfied; and if there be not assets for the payment of the debts, the executor is answerable for it to the creditors. In this case, it is the same whether the executor accepts or refuses the executorship. On the other hand, if the debtor makes the creditor his executor, and the creditor accepts the executorship, if there be assets, he may retain his debt out of the assets against the creditors in equal degree with himself; but if there be not assets, he may sue the heir, when the heir is bound. 1 Inst. 264. b in n. See *EXECUTOR*.

Littleton says, that a release of all demands is the best release to him, to whom it is made; and Coke says, that the word "demand" is the largest word in law, except "claim;" and that a release of all demands discharges all sorts of actions, rights, and titles, conditions before or after, breach, executions, appeals, rents of all kinds, covenants, annuities, contracts, recognizances, statutes, commons, &c. (Litt. §. 508. Co. Litt. 291.) A release of all actions discharges a bond to pay money on a future day. But a release of actions does not discharge a rent before the day of payment. (Co. Litt. 292.) By a release of all manner of actions, all actions, as well criminal as real, personal and mixed, are released. Co. Litt. 287. See Jacob's Law Dict. by Tomlins.

RELEGATION, *RELEGATIO*, a kind of exile or banishment, by which the obnoxious person is commanded to retire to a certain place prescribed, and to continue there till he be recalled.

Lord Coke calls relegation a banishment for a time only; Courtin more adequately defines relegation a banishment to a certain place for a certain term.

In Rome, relegation was a less severe punishment than deportation, in that the relegated person did not thereby lose the rights of a Roman citizen, nor those of his family, as the authority of a father over his children, &c.

RELHANIA, in *Botany*, received that name from the pen of the late M. l'Heritier, in honour of the Rev. Richard Relhan, F.R.S. and A.L.S., author of the *Flora Cantabrigienfis*. — L'Herit. Sert. Angl. 22. Schreb. 563. Willd. Sp. Pl. v. 3. 2135. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 5. 91. Thunb. Prodr. 145. Poiret in Lamarck Dict. v. 4. 93. (Eclupes; Gærtn. t. 169. Lamarck Illustr. t. 689.)—Clas and order, *Syngenesia Polygamia-superflua*. Nat. Ord. *Compositæ discoidæ*, Linn. *Corymbifera*, Juss.

Gen. Ch. *Common calyx* oblong, imbricated, with oblong chaffy scales. *Cor.* compound, radiated; united florets in the disk numerous, tubular, funnel-shaped, five-cleft; female ones in the radius ligulate, ovate-oblong.

Stam.,

Stam., in the perfect florets, filaments five, very short; anthers combined into a tube. *Pist.* in the perfect florets, germen oblong; style simple; stigmas two, reflexed: in the female ones, germen oblong, rather incurved; style simple; stigmas two, recurved. *Peric.* none, except the permanent unchanged calyx. *Seeds*, to all the florets alike, solitary, angular, with a membranous, many-cleft, short crown. *Recept.* chaffy.

Eff. Ch. Receptacle chaffy. Seed-crown membranous, short, cylindrical. Calyx imbricated, chaffy. Florets of the radius numerous.

M. P'Heritier distinguishes this genus from *Athanasia* by the presence of a radius; from *Osmites* by the florets of that radius producing perfect seeds; and from *Leysera* by the want of a feathery seed-down. Gärtner remarks that his *Eclopes*, adopted from sir Joseph Banks's and Dr. Solander's papers, is nothing more than an *Athanasia*, furnished with a radius. A due attention to the syngenetic class soon teaches us to mistrust this character, which is unstable, even in several species of that class; witness the genera *Coreopsis* and *Bidens*. Still less is the fertility or barrenness of the radiant florets capable of distinguishing natural genera, though Linnæus has, unadvisedly, founded a distinction of orders, in the class in question, upon those differences. We cannot but assent, therefore, to the opinion of Poiret, that the genus of *Relbania* is not naturally distinct from the Linnæan *Osmites*, at least, which last name being already established, ought to have been retained. However striking the radiating, chaffy, shining inner scales of the calyx may be in a few species of *Osmites*; approaches towards that character are found in the *Relbania*, as *genissifolia*, and still more in *paleacea*. We are far from intending to do away the claims of our friend, Mr. Relhan, to botanical commemoration, even were that honour bestowed in general far less indiscriminately than it is. For the present, the *Relbania* of L'Heritier is received; and if that be at any time abolished, there ought to be one established on more solid principles.

Willdenow has nineteen species of this supposed genus; all natives of the Cape of Good Hope, mostly of a shrubby bushy habit, green-house plants in England, where only one of them indeed appears to be cultivated. Their flowers are mostly corymbose, small, of a dull yellow, not remarkable for beauty. We select a few examples.

R. squarrosa. Hook-leaved Relbania. Willd. n. 1. Ait. n. 1. (*Athanasia squarrosa*; Linn. Sp. Pl. 1180. Amoen. Acad. v. 6. 98. *Santolina squarrosa*; Linn. Am. Acad. v. 4. 329.)—Leaves elliptical, pointed; recurved at the point.—Sent to Kew by Mr. Mallon, in 1794. It flowers in the green-house in May and June. The whole *shrub* is smooth, much branched. *Leaves* numerous, somewhat imbricated, about a quarter of an inch long, elliptical, obscurely single-ribbed beneath, entire, acute; strongly recurved, smooth, finely dotted on both sides. *Flowers* solitary, on slender axillary stalks, thrice the length of the leaves. *Calyx* about half an inch long, very smooth, rather shining. This should seem a different plant from *R. squarrosa* of Thunberg, who defines his “with terminal umbels,” and has thus led Willdenow, contrary to the description of Linnæus, to refer the species in question to the first section of the genus, “with aggregate flowers.” It appears, by specimens in the Linnæan herbarium, that the flowers are sometimes so crowded about the ends of the branches, as to assume a corymbose appearance, though each stalk is really axillary. Such a specimen probably was described by Thunberg.

R. genissifolia. Broom-leaved Relbania. Willd. n. 2.

(*Athanasia genissifolia*; Linn. Syst. Nat. ed. 12. v. 2. 340. Mant. 464.)—Leaves obovato-lanceolate, pointed, single-ribbed beneath, entire, smooth, somewhat imbricated. Flowers terminal, umbellate.—A bushy *shrub*, very much branched. *Leaves* a quarter of an inch, or hardly so much, in length, numerous, crowded, dotted, entire, smooth; the lower ones obovate, and smallest; the upper more lanceolate and elongated; all bluntish, with a minute, often hooked, point, and single-ribbed at the back only. *Flowers* smaller than the preceding, from five to eight together, in little terminal umbels. *Calyx* shining.

R. viscosa. Glutinous Relbania. L'Herit. Sert. 23. Willd. n. 5. (*Eclopes viscosa*; Gärtner. v. 2. 440. t. 169.)—Leaves linear-lanceolate, pointed, viscid, obscurely single-ribbed beneath, rather fleshy; the upper ones somewhat crenate.—The flowers are much like the last-mentioned; but the leaves are twice as large, more elongated in shape, more slightly ribbed, the edges of the upper ones rough or crenate, and all of them extremely glutinous. When bruised, the dried leaves are found to retain a powerful aromatic scent, approaching to that of orange-peel.

R. pedunculata. Long-stalked Dwarf Relbania. L'Herit. Sert. Angl. 23. Willd. n. 7. (*R. pumila*; Thunb. Prodr. 146. *Athanasia pumila*; Linn. Suppl. 362. *Zoegea capensis*; ibid. 382.)—Leaves linear, villous, and glandular. Stem diffuse. Flower-stalks axillary, much longer than the leaves.—A small herbaceous annual species, whose root is furnished with numerous capillary fibres. Stem a span high, branched from the base, round, purplish, spreading; glandular and slightly cottony in the upper part, as well as the leaves; which are about an inch long, very narrow, somewhat triangular. Flowers small, yellow, on long, stoutish, downy, axillary stalks, about the summits of the branches. This occurs twice in the *Supplementum*, having, in one instance, been described by Linnæus himself, from a wild specimen, and in the other, adopted by his son, unseen, from Thunberg's communications.

R. paleacea. Chaffy-flowered Relbania. L'Herit. Sert. Angl. 24. Willd. n. 11. Thunb. Prodr. 146. (*Leysera paleacea*; Linn. Syst. Veg. ed. 13. 641. *L. ericoides*; Berg. Cap. 294. *Eclopes*; Lamarck f. 2? *Afterophorus fruticosus luteus*, foliis rorismarini crebris, ovariis hirsutis; Vaill. Act. German edition, 585.)—Leaves linear, triangular, channelled, hoary; recurved at the point. Flowers terminal, solitary, sessile. Calyx turbinate.—Communicated by Van Royen to Linnæus, and by Sherard, as it appears, to Vaillant. The stem is shrubby, a span high, branched. Leaves numerous, about an inch long, narrow, clothed, as well as the young branches, with fine hoary down. Calyx ovate, smooth, a quarter of an inch in diameter; its inner scales much elongated, lanceolate, acute, and membranous, resembling the scales of the receptacle, which stand prominent and erect, above the florets of the disk. This plant has so much of the external aspect of *Leysera gnaphalodes*, that we can hardly wonder at Linnæus, for having referred it, by the habit alone, to the same genus. Upon a careful examination, however, the characters, and even the appearance, of the parts of fructification, are abundantly different in the two plants.

Most of the other species of *Relbania*, in Willdenow, are adopted from the short specific definitions of Thunberg and L'Heritier; nor have we been able to determine them all with certainty. It is remarkable that no figure of any has appeared, except in Gärtner and Lamarck, nor is the latter very happy or discriminative, in what he has exhibited of this genus, called by him, after Gärtner, *Eclopes*.

RELICS, RELIQUÆ, in the *Romish Church*, certain remains

remains of the body or clothes of some saint or martyr, devoutly preserved in honour to his memory, carried at processions, killed, revered, &c.

The abuses of that church in point of relics have been very flagrant. F. Mabillon, a Benedictine, complains of the great number of suspected relics exposed on altars: he owns, that were there to be a strict inquisition into the relics, vast numbers of spurious ones would be found offered every where to the piety and devotion of the faithful; and adds, that bones are frequently consecrated, so far from belonging to saints, that, in all probability, they do not belong to Christians.

The catacombs are an inexhaustible fund of relics; yet it is still disputed who were the persons interred in them.

In the eleventh century, a method was introduced of trying supposed relics by fire. Those which did not consume in the fire were reputed genuine; the rest not.

It is an ancient custom, which still obtains, to preserve the relics in the altars on which mass is celebrated. To this purpose, a square hole is made in the middle of the altar, big enough to receive the hand; and in that is the relic deposited, being first wrapped in red silk, and inclosed in a leaden box.

The Romanists allege a considerable degree of antiquity in behalf of their relics. The Manichees, it seems, out of hatred to the flesh, which they held an evil principle, are recorded as refusing to honour the relics of saints; which is esteemed a kind of proof, that the Catholics did it in the first ages.

Indeed, folly and superstition blended themselves with religion at too early a period. Even the touching of linen cloths on relics, from an opinion of some extraordinary virtue derived from them, appears to be as ancient as the first ages; there being a hole made in the coffins of the forty martyrs at Constantinople, expressly for this purpose.

This practice of honouring the relics of saints, on which the church of Rome, in succeeding ages, founded her superstitious and lucrative use of them, as objects of devotion, as a kind of charms or amulets, and as instruments of pretended miracles, seems to have originated in a very ancient custom, that prevailed among Christians, of assembling at the cemeteries or burying-places of the martyrs, for the purpose of commemorating them, and of performing divine worship. When the profession of Christianity obtained the protection of the civil government, under Constantine the Great, stately churches were erected over their sepulchres, and their names and memories were treated with every possible token of affection and respect. (See SAINTS.) In process of time, this reverence of the martyrs exceeded all reasonable bounds; and those prayers and religious services were thought to have a peculiar sanctity and virtue, which were performed over their tombs. Hence probably proceeded the practice, already mentioned, which obtained in the fourth century, of depositing relics of the saints and martyrs under the altars in all their churches. This practice, however, was then thought of such importance, that St. Ambrose would not consecrate a church, because it had no relics; and the council of Constantinople in Trullo ordained, that those altars should be demolished, under which there were found no relics. The rage of procuring relics for this and other purposes of a similar nature became so excessive, that, in 386, the emperor Theodosius the Great was obliged to pass a law, forbidding the people to dig up the bodies of the martyrs, and to traffick in their relics.

Such was the commencement of that respect for sacred

relics, which, in after ages, was perverted into a formal worship of them, and became the occasion of innumerable processions, pilgrimages, and miracles, from which the church of Rome hath derived incredible advantage. Towards the close of the ninth century, it was not enough to reverence departed saints, and to confide in their intercessions and succours: it was not enough to clothe them with an imaginary power of healing diseases, working miracles, and delivering from all sorts of calamities and dangers; their bones, their clothes, the apparel and furniture they had possessed during their lives, the very ground which they had touched, or in which their putrified carcases were laid, were treated with a stupid veneration, and supposed to retain the marvellous virtue of healing all disorders both of body and mind, and of defending such as possessed them against all the assaults and devices of Satan. The consequence of this wretched notion was, that every one was eager to provide himself with these salutary remedies; for which purpose, great numbers undertook fatiguing and perilous voyages, and subjected themselves to all sorts of hardships; while others made use of this delusion, to accumulate their riches, and to impose upon the miserable multitude by the most impious and shocking inventions. As the demand for relics was prodigious and universal, the clergy employed all their dexterity to satisfy these demands, and were far from being nice in the methods they used for that end. The bodies of the saints were sought by fasting and prayer, instituted by the priest, in order to obtain a divine answer and an infallible direction; and this pretended direction never failed to accomplish their desires: the holy carcase was always found, and that always in consequence, as they impiously gave out, of the suggestion and inspiration of God himself. Each discovery of this kind was attended with excessive demonstrations of joy, and animated the zeal of these devout seekers to enrich the church still more and more with this new kind of treasure. Many travelled with this view into the Eastern provinces, and frequented the places which Christ and his disciples had honoured with their presence, that, with the bones and other sacred remains of the first heralds of the gospel, they might comfort dejected minds, calm trembling consciences, save sinking states, and defend their inhabitants from all sorts of calamities. Nor did these pious travellers return home empty; the craft, dexterity, and knavery of the Greeks found a rich prey in the stupid credulity of the Latin relic-hunters, and made a profitable commerce of this new devotion. The latter paid considerable sums for legs and arms, skulls and jaw-bones, (several of which were Pagan, and some not human,) and other things that were supposed to have belonged to the primitive worthies of the Christian church: and thus the Latin churches came to the possession of those celebrated relics of St. Mark, St. James, St. Bartholomew, Cyprian, Pantaleon, and others, which they shew at this day with so much ostentation. But there were many, who, unable to procure for themselves these spiritual treasures by voyages and prayers, had recourse to violence and theft: for all sorts of means, and all sorts of attempts, in a cause of this nature were considered, when successful, as pious and acceptable to the Supreme Being.

Besides the arguments from antiquity to which the Papists refer, in vindication of their worship of relics, of which the reader may form some judgment from this article, Bellarmine appeals to scripture in support of it, and cites the following passages, *viz.* Exod. xiii. 19. Deut. xxxiv. 6. 2 Kings, xiii. 21. 2 Kings, xxiii. 16, 17, 18. Isaiah, xi. 10. Matth. xi. 20, 21, 22. Acts, v. 12—15. Acts, xix. 11, 12. See **POPERY**.

Relics are forbidden to be used or brought into England by several statutes; and justices of peace are empowered to search houses for Popish books and relics, which, when found, are to be defaced and burnt, &c. 3 Jac. I. cap. 26.

RELICT, RELICTA, in *Law*. See WIDOW.

RELICTA VERIFICATIONE, is when a defendant relinquishes his proof or plea, and thereupon judgment is entered for the plaintiff.

RELIEF, RELEVUM, *Levamen*, a fine paid the chief lord, by a person at his coming to the inheritance of land held by military service.

This was said *relevare hereditatem caducam*; and the money thus paid was called *relevamen*, *relevum*, or *relief*. Relief is usually to the value of a year's rent or revenue.

The origin of the custom is thus: a feudatory or beneficiary estate in lands being at first only granted for life, after the death of the vassal, it returned to the chief lord; and was hence called *feudum caducum*, *q. d.* fallen to the lord by the death of the tenant.

In course of time, these feudatory estates being converted into inheritances by the connivance and consent of the lord; when the possessor of such estate died, it was called *hereditas caduca*, *q. d.* an inheritance fallen to the lord, from whom it was to be recovered, by the heir's paying a certain sum of money. But this sum was arbitrary, and at the will of the lord; so that, if he pleased to demand an exorbitant relief, it was in effect to disinherit the heir. The English ill brooked this consequence of their new-adapted policy; and, therefore, William the Conqueror by his laws (cap. 22, 23, 24.) ascertained the relief, by directing (in imitation of the Danish heriots), that a certain quantity of arms and habiliments of war should be paid by the earls, barons, and vavasours respectively; and if the latter had no arms, they should pay 100s. William Rufus broke through this composition, and again demanded arbitrary uncertain reliefs, as due by the feudal laws; thereby in effect obliging every heir to new-purchase or redeem his land: but his brother Henry I. by his charter, restored his father's law; and ordained that the relief to be paid should be according to the law so established, and not an arbitrary redemption. But afterwards, when, by an ordinance in 27 Hen. III. called the Assize of Arms, it was provided that every man's armour should descend to his heir, for defence of the realm, and it thereby became impracticable to pay these acknowledgments in arms, according to the laws of the Conqueror, the composition was universally accepted of 100s. for every knight's fee; as we find it ever after established. (Glanv. l. ix. c. 4. Litt. § 112.) But it must be remembered, that this relief was only then payable, if the heir at the death of his ancestor had attained his full age of twenty-one years.

RELIEF, *Reasonable*, called also *lawful* and *ancient* relief, is that enjoined by some law, or fixed by ancient custom; and which does not depend on the will of the lord.

Thus in a charter of king John, mentioned by Matthew Paris:—"Si quis comitum vel baronum nostrorum, five aliorum tenentium de nobis in capite per servitium militare, mortuus fuerit, & cum decesserit, hæres suus plenæ ætatis fuerit, & relevum debet, habeat hereditatem suam per antiquum relevum."

What this was, may be seen in the laws of William the Conqueror, &c. Bracton says this fine was called a relief, "quia hereditas, quæ jacens fuit per antecessoris decessum, relevatur in manus hæredum, &c."

A relief is also paid in socage-tenure, or petit serjeanty; where a rent, or other thing, is paid by rendering as much

as the rent or payment reserved. But the manner of taking relief upon socage-tenure is very different from that upon tenure in chivalry. The relief on a knight's fee was 5*l.*, or one-quarter of the supposed value of the land; but a socage-relief is one year's rent or render, payable by the tenant to the lord, be the same either great or small (Litt. § 126.); and, therefore, Bracton (l. 2. c. 37. § 8.) will not allow this to be so properly a relief, but "quædam præstatio loco relevii in recognitionem domini." So, too, the statute 28 Edw. I. c. 1. declares, that a free sokeman shall give no relief, but shall double his rent after the death of his ancestor, according to that which he hath used to pay his lord, and shall not be grieved above measure. Reliefs in knight-service were only payable, if the heir at the death of his ancestor was of full age; but in socage they were due even though the heir was under age, because the lord has no wardship over him. (Litt. § 127.) The statute 12 Car. II. reserves the reliefs incident to socage-tenures; and, therefore, whenever lands in fee-simple are holden by a rent, relief is still due of common right upon the death of a tenant. 3 Lev. 145.

By the custom of Normandy, relief is due for lands held in villinage as well as in fee. By the custom of Paris, relief is not due upon inheritances in the direct line.

The quantity of the relief is very different; there are *single* reliefs, *double* reliefs, &c. The quality, too, is diverse: there are *reliefs of property*, paid by the heir; *reliefs of bail*, or *tutorage*, paid by the guardian for his minor, or by the husband for the fiefs of his wife, &c.; *relief of horse and arms*, &c.

By the laws of king Canutus, the relief of an earl, paid to the king, was eight war horses with their bridles and saddles, four cuirasses, four helmets, four swords, four hunting-horses, and a palfrey. The relief of a baron or thane was four horses, &c.

RELIEF, in *Chancery*, denotes an order sued out for the dissolving of contracts, and other acts, on account of their being unreasonable, prejudicial, grievous, or from some other nullity, either *de jure*, or *de facto*.

Minors obtain relief against acts passed in their minority. Majors have relief in cases of enormous damage, deceit, violence, over-reaching, extravagant bargains, &c.

Among the Romanists it is a rule, that the church obtains relief any time, and against all acts passed in its prejudice; no prescription prevailing against it.

RELIEF, *Aid de*. See AID.

RELIEF of a *Hare*, among *Hunters*, is the place where she goes to feed in the evening.

RELIEF, in *Sculpture*. See RELIEVO.

RELIEVE, in the *Military Sense*. To relieve, is to take the post of another body. Hence, to relieve the guard, to relieve the trenches, &c. is to bring fresh men upon the guard, or to the trenches, and to send those to rest who have been upon duty before. They also say, relieve a sentinel, which is generally done every two hours, by a corporal who attends the relief; relieve the steerfman, &c.

To relieve a place that is besieged, is to furnish it with a supply of men, provisions, ammunition, &c.

RELIEVER, in *Artillery*, is an iron ring fixed to a handle by means of a socket, so as to be at right angles to it. It serves to disengage the first searcher of a gun, when any of its points are retained in a hole, and cannot be got out otherwise.

RELIEVING TACKLES, in a *Ship*, are two strong tackles, used to prevent a ship from overturning on the careen, and to assist in bringing her upright after that operation is completed. The relieving tackles are furnished

with two strong *guys*, or pendants, by which their efforts are communicated, under the ship's bottom, to the opposite side, where the ends of the guys are attached to the lower gun-ports. The other ends of the tackles are hooked to the wharf or pontoon, by which the vessel is careened. Thus, if a ship is first to be laid down on the larboard side, which is nearest the wharf, the relieving tackles are passed under her bottom from the said wharf, and attached to the starboard side, by which they will restrain her from falling lower than is necessary. Falconer.

RELIEVING Tackle, is also a name given to the train tackles of a gun-carriage.

RELIEVO, or **RELIEF**, *Imbossment*, is applied to a figure which projects, or stands out prominent, from the ground or plane on which it is formed, whether that figure be cut with the chissel, moulded, or cast. There are three kinds of relieve; *viz. alto, basso, and demi-relievo*.

RELIEVO, *Alto, haut relief, or high relievo*, is when the figure is formed after nature, and projects as much as the life.

RELIEVO, *Basso, bas relief, or low relievo*, is when the work is but raised a little from its ground, as we see in medals, and in the frontispieces or buildings, particularly the histories, festoons, foliages, and other ornaments in friezes. See *BASSO Relievo*.

RELIEVO, *Demi*, is when one-half of the figure rises from the plane, *i. e.* when the body of a figure seems cut in two, and one-half is clapped on a ground. When in a basso relievo there are some parts that stand clear out, detached from the rest, the work is called a *demi-bosse*.

RELIEVO, in *Architecture*, denotes the sally or projection of any ornament.

This, Daviler observes, is always to be proportioned to the magnitude of the building it adorns, and the distance at which it is to be viewed.

If the work be insulate, and terminated on all sides, it is called a *figure in relievo*, or a *round embossment*. Such are statues, acroters, &c.

RELIEVO, in *Painting*, denotes the degree of force or boldness by which a figure seems, at a due distance, to stand out from the ground of the painting, as if really embossed.

The relievo depends much on the depth of the shadow, and the strength of the light; or on the light of the different colours bordering on one another; and particularly on the difference of the colour of the figure from that of the ground.

When the light is well chosen, to make the nearest parts of figures advance; and well diffused on the masses, still diminishing insensibly, and terminating in a large specious shadow, brought off insensibly; the relievo is said to be *bold*, and the *claire obscure, well understood*.

RELIGION, **RELIGIO**, that worship or homage that is due to God, considered as Creator, Preserver, and, with Christians, as Redeemer of the world.

The foundation of all religion is, that there is a God; and that he requires some acknowledgment and service from his creatures.

Accordingly, religion, in the true meaning of the term, necessarily supposes and includes an intercourse between God and man; *i. e.* on the part of God discoveries and manifestations of himself and his perfections, and of his will with regard to the duties which he requires; and on the part of man, a capacity and readiness to receive and improve those discoveries, and to conform to all the significations of the divine will. For it is an undeniable principle, that whatsoever plainly appeareth to be the mind and

will of God, whatever be the way in which we obtain the knowledge of it, we are indispensibly obliged to observe. And as there are two ways by which God may be supposed to manifest himself and his will to mankind, *viz.* by his works and by his word, religion has been usually distributed into *natural* and *revealed*. These are not two kinds of religion, essentially different, much less contrary or contradictory to each other, because they both have God for their object, and proceed from him; nor are they altogether the same, and differing merely in the mode of their communication. Although all true revealed religion must be consistent with, and in no respect contrary to, the clear light of nature and reason, yet it may discover and reveal several things pertaining to truth and duty, which that light, if left to itself, could not have discovered at all, or not with sufficient clearness and certainty. These should not be opposed to one another; nor is the one of them designed to exclude the other.

RELIGION, *Natural*, has been taken in different acceptations. Some understand by it every thing in religion, with regard to truth and duty, which, when once discovered, may be clearly shewn to have a real foundation in the nature and relations of things, and which unprejudiced reason will approve, when fairly proposed, and set in a proper light. Accordingly some Christian philosophers and divines have comprehended under their scheme or system of natural religion, a considerable part of what is contained in the scripture revelation, *e. gr.* the important truths and principles relating to the existence, the unity, and attributes of God, his governing providence and moral administration, the worship that is due to him, the law that is given to mankind; or the whole of moral duty in its just extent, as relating to God, our neighbours, and ourselves, the rewards and punishments of another state, and other articles nearly connected with these, and dependent upon them. Having taken great pains to shew, that all this is perfectly agreeable to sound reason, and founded in the nature of things, they have honoured the whole with the name of *natural religion*. None can hesitate to allow, that it is a real and great service to religion to shew, that the main principles and duties of it are what reason must approve; and those are unquestionably entitled to praise, who have undertaken to demonstrate this with great clearness and force of argument. But it does not follow that, because these things, when once clearly discovered, may be proved agreeable to reason, and to have a real foundation in the nature of things, reason alone, in the present state of mankind, if left to itself, without higher assistance, would merely, by its own force, have discovered all of them, with their genuine consequences, and have applied them to their proper uses, for directing men in the true knowledge and practice of religion. Many things, says Mr. Locke, in his "Reasonableness of Christianity," are taken for unquestionable truths, and easily demonstrable, without considering how long we might have been in doubt or ignorance respecting them, if revelation had been silent. Native and original truth is not so easily wrought out of the mine, as we who have it ready dug and fashioned to our hands, are apt to imagine. To the same purpose Dr. Clarke observes, (Disc. on Nat. and Rev. Religion,) that it is one thing to see, that these rules of life, which are before-hand plainly and particularly laid before us, are perfectly agreeable to reason, and another thing to find out these rules merely by the light of reason, without their having been first otherwise made known. Accordingly some able and strenuous assertors of natural religion, or the law of nature, though they contend that it is founded in the nature of things,

things, and agreeable to right reason, derive the promulgation of it from divine revelation. Hence it may be concluded, that natural religion, or the *LAW of Nature* (which see), is not so called, because it was originally discovered by natural reason, but because, when once made known, it is what the reason of mankind, duly exercised, approves, as founded in truth and nature.

Natural religion, in the sense now explained, is very consistent with the supposition of an extraordinary divine revelation, for the purpose of discovering and promulgating it at first, and also of re-establishing and confirming it, when, through the corruption of mankind, the important principles and duties of it were sunk into such darkness, and so confounded with pernicious errors, that an extraordinary assistance was necessary to recover men to the right knowledge and practice of it.

Natural religion is understood by others in a sense which is absolutely exclusive of all extraordinary revelation, and in direct opposition to it. By natural religion, they mean that religion which men discover by the sole exercise of their natural faculties and powers, without any other or higher assistance. These persons discard all pretences to extraordinary revelation, as the effects of enthusiasm or imposture. It is in this sense, that those who call themselves *DEISTS* (see that article) understand natural religion, which they highly extol as the only true religion, the only discovery of truth and duty upon which we may safely depend; and which comprehends the whole of what is necessary to be known and done, in order to our obtaining the favour of God, and attaining to true happiness. But those who take natural religion in this sense entertain different opinions of the subject, and express their sentiments variously. The ablest advocates for natural religion, as opposed to revelation, maintain, that it is clear and obvious to the whole human race, and that all men have a natural knowledge of it. They argue, that since religion is equally the concern of all mankind, the wisdom and goodness of God require, that it should be actually known to all. To this purpose is the reasoning of lord Herbert, who alleges, that God hath imprinted on the minds of all men innate ideas of the main principles of religion and morality. Tindal also, and the author of "*Christianity as old as the Creation*," argue in a similar manner: the former asserts, that this clear universal light that shines into the minds of all men cannot be made clear to any man by an external extraordinary revelation: with the latter it is a kind of fundamental principle, that the law, or religion, of nature was a perfect scheme of religion and morality, fairly drawn on the mind and heart of every man, in such a manner, that it is not possible for any man to mistake it: and he even affirms, that the most illiterate of the human race have naturally and necessarily a clear and intimate perception of the whole of religion and of their duty. Hence it will be easily owned, that there is no need of an extraordinary revelation to teach men what they all naturally and necessarily know. This scheme, however plausible it may at first appear, and though it seems to exhibit a beautiful representation of the dignity of our species, and of the universal goodness of God to the human race, appears to be altogether visionary, when brought to the test of fact and experience: whilst it supposes, that religion, in its true nature and just extent, is naturally known to all men, so that they cannot mistake it, it contradicts the testimony of the authentic history of mankind in all ages, which evinces that they have mistaken religion in its important principles and obligations.

Sensible of the inconveniences of this scheme, others, by natural religion, understand not merely that which is na-

turally and necessarily known to all men, but that which reason, duly exercised and improved, is able, by its own natural force, to discover, without the assistance of any extraordinary revelation. In order to form a just conception of this theory, we might investigate the extent of the powers and abilities of human reason in judging concerning matters of religion, independently of all revelation: but without entering on a speculation of this kind, the disquisition of which would be more curious in the process than satisfactory in the result, we should recur to the surest and plainest mode of judging, which is the examination of the conclusions that may be deduced from fact and experience. Let us then inquire, what hath human reason actually done in this way, by its own force, without any extraordinary assistance? The satisfactory answer to this inquiry cannot be obtained from any systems formed by persons who have lived in ages and countries which have enjoyed the light of divine revelation; since in this case it may reasonably be supposed, that they have borrowed light from revelation, though they are not willing to acknowledge it, or may not themselves be sensible of it. Systems, therefore, that have been drawn up by our modern admirers of natural religion in Christian countries, cannot be alleged in proof of the force of unassisted reason in matters of religion; and the same may be said of those Pagan philosophers who have lived after Christianity had made some progress in the world. Nor can we fairly infer the sufficiency of the light of natural reason, without the aid of revelation, from the systems of the ancient philosophers, lawgivers, and moralists, who lived before the Christian revelation was published; unless it can be shewn, that they themselves derived the religious and moral principles which they taught, solely and entirely from the researches and disquisitions of their own reason, and disclaimed their having had any assistance, with regard to those truths and principles, from tradition or divine instruction. And it is no hard matter to shew, by testimonies from the most celebrated ancients, that this was not the case, nor was it what they assumed to themselves. It is well known, that the most admired philosophers of Greece did not pretend to set up merely on their own stocks, but travelled into Egypt, and different parts of the East, for the purpose of improving their knowledge by conversation with the sages of those countries; who themselves professed to have derived their knowledge, not merely from the disquisitions of their own reason, but from a higher source, from very ancient traditions, to which, for the most part, they assigned a divine original. After all it must be allowed, that the most celebrated and sagacious of the ancient philosophers made pathetic complaints of human darkness and ignorance, and of the great difficulties they experienced in searching after truth. Many of them were sensible of the great need there was of divine instruction and assistance, for enlightening and directing mankind in matters of religion and their duty: so that no argument can be justly drawn from the wise men and philosophers among the ancients, to shew that the knowledge of what is usually called natural religion, in its just extent, is wholly and originally owing to the force of human reason, exclusive of all divine revelation. And perhaps, says the excellent writer whose observations we are now citing, it would not be easy to mention any nations, among whom any true knowledge of religion has been preserved, concerning which we can be assured, that they never had any benefit from the light of divine revelation; and that the principles of religious truth and duty, which were to be found among them, were originally the mere product of natural reason, without any higher assistance. Several things may be observed among them, which

seem to be the remains of an ancient universal tradition, or primeval religion, derived from the remotest antiquity, and which, probably, had their original source in divine revelation, though in process of time it was greatly altered and corrupted. Leland's *Advantage and Necessity of the Christian Revelation*, vol. i. § 1.

RELIGION, *Revealed*, is commonly understood to be that knowledge of religion, which was originally communicated from God to men in a way of extraordinary revelation, for instructing them in important religious truth, and directing and engaging them to the practice of their duty. In a general sense, all truth, and the manifestation of it, may be said to come from God, even that which we discover in the ordinary use of those rational faculties which God hath given us. But revealed religion, as distinguished from that which is usually called natural, denotes that knowledge of religion which was originally communicated in an extraordinary and supernatural way. Leland, *ubi supra*. See REVELATION.

The first kind of religion, above-mentioned, or natural religion, flows immediately from the relation between the creature and the Creator; the latter, or revealed religion, does not follow from such a relation, but is superadded from the mere will and pleasure of the Creator.

The first we ordinarily call morality, or ethics; because immediately conversant about the manners and duties of men towards one another; and towards themselves, considered as creatures of that Being. See ETHICS, MORALITY, and MORAL PHILOSOPHY.

The latter we call, by way of eminence, religion, as being the rule of our duty immediately to God himself.

The first supposes a God, a providence, and a future state, of rewards and punishments; the latter likewise supposes an immediate mission from God himself, attested by miracles, &c. See CHRISTIAN Religion.

RELIGION is more particularly used for that special system of faith and worship, which obtains in a particular age, sect, or country, &c.

In this sense we say the Romish religion, the Reformed religion, the religion of the Greeks, the Mahometan religion, the Jewish religion, &c. See JUDAISM, MAHOMETANISM, &c.

The Siamese hold the diversity of religions, *i. e.* the different manners of honouring God, to be pleasing to him; inasmuch as they have all the same object, and all tend to the same end, though by different means. Claude.

This sentiment of these idolaters is doubtless more just than that of our zealots, who hold all but those of their own religion odious to God. The several sects in religion see under their proper articles. See also SECT.

Of the religion of the ruling part of the world, you may find a lively description in a chorus in Seneca's *Troas*, at the end of the second act, beginning thus: "Verum est, an timidus fabula decipit? umbras corporibus vivere conditis, &c." This, according to Patin, is the religion of princes, and great men, of magistrates, monastic superiors, and even some physicians and philosophers. M. Du Maine, head of the leaguers in France, used to say, that princes have no religion till after they are turned of forty. "Cum numine nobis mors instat, majore facit." Patin. *Lett. Chois.* 106.

Under this article we are naturally led to discuss the subject of national religion, in its connection with religious establishments. It must appear, on the slightest reflection, that religion has a very considerable influence, not only on the disposition and character of individuals, but on the state of society in general. Accordingly legislators and rulers have often found it one of the most powerful instruments of

civil policy; and the history of almost every country affords numerous instances of its being an excellent ally to the power of the civil magistrate, or the most dangerous rival. By religion we now mean that principle which influences men by the dread of evil or the hope of reward, from unknown and invisible causes; whether the good or the evil be expected to take place in this world or in another; and in this general sense of the term, it comprehends enthusiasm, superstition, and every other species of false religion as well as the true. It would lead us too far, if we attempted to trace the influence of this principle in the more barbarous or more civilized nations of antiquity. Enthusiasm and superstition have been more powerful and more efficacious on many occasions, which history records, than political wisdom in the cabinet, or martial skill and valour in the field. In some cases religion has concurred with the views of the civil magistrate; and in others, it has counteracted them even in favour of the best interests of mankind. It is an observation of Mr. Hume's, that the precious sparks of liberty were kindled and preserved by the Puritans in England, and that it is to this sect, whose principles appear so frivolous, and whose habits so ridiculous, as he somewhat invidiously describes them, that the English owe the whole freedom of their constitution. The assertion, however, is too general. The capital advantage derived from Christianity in this western part of the world, is the total abolition of slavery, in consequence of its raising men's ideas of the importance of the human species. It is a memorable fact, that after the introduction of Christianity into the Roman empire, every law which was made relating to slaves was in their favour, till at last all the subjects of the empire were reckoned equally free. Although, in later times, slavery has been revived and continued, for commercial purposes, in countries calling themselves Christian, we trust that laudable efforts, originating in the liberal sentiments and affections which Christianity inculcates, will be crowned with success, and gradually annihilate this nefarious kind of traffick in every nation of the globe. Christianity, indeed, is almost incompatible with absolute despotic power, both in sovereigns and private persons. The corruptions of Christianity, exemplified in the exorbitant power of the pope, and the superstition of the Popish worship, have been indirectly productive of considerable benefit. The union of the western churches under one supreme pontiff facilitated the intercourse of nations in barbarous ages; and the pomp of the Popish power contributed in no small degree towards preventing the fine arts from being totally lost in the barbarism of Europe, and to their subsequent revival, previously to that of literature and science in this western part of the world. Erroneous notions of religion, and the superstition blended with its purer principles, have been, however, the occasion of the most lamentable evils in the government of states. Beccaria says, in his "Essay on Crimes and Punishments," that more than 100,000 witches have been condemned to die by Christian tribunals. False principles of religion have encouraged men to commit the most horrid crimes; and to inflict tortures both on themselves and others, which cannot be thought of without horror. The historical page of persecution is stained with blood. But it is our present design to sketch out the benefits resulting from religion to civil society, rather than the evils which the perversion of its principles and genuine spirit have produced. It is natural to imagine, that the civil magistrate would take religion under his protection with a view to these benefits; nevertheless, it is much to be lamented that by erroneous notions of its nature and design, and a misapplication of its influence, it has been rendered the instrument

strument of tyranny and oppression. If magistrates and rulers availed themselves of the assistance which religion affords for meliorating the character and condition of the members of the community over which they preside; if they patronized and encouraged the principles and profession of it for the purpose of restraining the profligate and vicious, and of promoting a virtuous conduct with a view to the welfare and prosperity of the state; and if they made use of the mighty powers with which religion furnishes them merely for the purpose of maintaining order and peace in the community to which they belong, and of securing and advancing its true interests; there could be no reason for alarm or complaint. Religion and civil government might unite their efforts for such laudable purposes, and co-operate in promoting them, without any apprehension of danger; but lamentable experience has testified that in too many instances religion has been made subservient to ambition and worldly policy, inasmuch that many persons of just reflection and comprehensive views have dreaded the interference of civil governors in matters of religion. If, in some cases, they have done good, in others their interference has been pernicious, not only to religion, which has been thus corrupted and degraded, but to the civil community itself. Nevertheless the opinion, that it is necessary for the state to prescribe the principles, and to regulate the modes of religion, has been almost universally prevalent.

We are thus led briefly to discuss the subject of national establishments of religion; and that we may do this without prejudice and partiality, we shall state the arguments on both sides of the question, as much as possible in the language of those who oppose, and of those who defend them. Amongst those who have thought freely, and who have written as freely on this subject, we find some who contend against establishments in any degree whatever. They will not allow that religion should receive any support from the state, but insist that it ought to be left entirely to its own operation. There is naturally, they say, no more connection between civil government and religion, than between the former and any thing else that depends upon opinion; less than the business of philosophy or religion. Because these respect the present life, with which civil governors have to do; whereas religion respects the life to come, with which they have nothing to do. However, the conclusiveness of this kind of reasoning seems to be materially affected by our preliminary remarks. Religion, it is said, is a concern that lies out of the proper province of the civil magistrate. Its object is invisible; its principles and affections, which are the springs of moral and religious conduct, as well as its motives and sanctions, are not subject to the direction and controul of secular counsel and power; its seat is the understanding and heart: nor is the external conduct, to which alone the cognizance of the civil magistrate extends, of any importance in a moral view, independently of the internal principles in which it originates, and by which it is guided and governed. Besides, it has been urged that civil rulers have no right to prescribe to the judgment in the province of religion, or to frame and enforce rules of moral conduct, for the observance or violation of which mankind are accountable only to God; nor are they competent or qualified for the exercise of such high powers. And if they cannot controul the faculties of the mind, their influence on the profession and practice, and that outward conformity to modes and rites of a religious nature which they may enforce, without the consent of the judgment and concurrence of the will, are calculated to do much greater harm than good; and to add to the number of hypocrites or martyrs. As the civil magistrate cannot bestow the rewards, nor inflict

the punishments, that are appropriate to religion; and as he cannot estimate the moral worth or demerit of his subjects, he cannot, without culpable presumption, assume, nor without intruding on the province of the supreme and almighty God, exercise the authority of a spiritual and final judge. Civil governors in general, such are their rank and station, the course of their education, and the habits of their lives, are less able than many others of lower condition, but of different views and connections, to decide concerning religious truth, or to determine who are qualified to advise and assist them. Moreover, it has been observed, that neither magistrates nor their ecclesiastical advisers are warranted to establish a standard either of religious faith or moral conduct, to which all the members of a community are required to conform, and from which they are not allowed to deviate without incurring some loss or damage. Such a standard, let it be ever so liberally framed, or ever so mildly enforced, is not likely to be so comprehensive, as to include all the teachers and all the professors of religion, who are entitled to the protection of the state in which their lot is cast. Besides, if such a standard of faith and practice could be devised, those who object to religious establishments on the ground now stated, conceive, that their civil rulers have no right to establish and impose it; and thus to deprive persons, who cannot approve it, of worldly honours and benefits, to which they have naturally an equal claim with others of their fellow-subjects;—a claim, which they do not forfeit by the exercise of their own judgment in the province of religion. It has also been argued, that Christianity, so far from countenancing, rather discourages every kind of religious establishment, that interferes with the right of private judgment. The language of the divine Author of our holy religion is, “Render to Cæsar the things that are Cæsar’s, and to God the things that are God’s;—Search the scriptures;—Call no man master on earth;—My kingdom is not of this world.” And that of his apostles, “Let every man be fully persuaded in his own mind;—Judge ye what I say;” &c. &c. The adversaries of establishments allege, that a national church, constituted by the civil magistrate, and governed by laws enacted by his authority, and the Christian church, founded on the doctrine of Christ and his apostles, are essentially distinct; and they say, that such a church, *e. gr.* the church of England, less exceptionable than many others, which claims and exercises, according to its 20th article, “power to decree rights and ceremonies, and authority in matters of faith,” has, agreeably to the true nature and constitution of the Christian church, no such power and authority; that it is inconsistent with the allegiance which Christians, as the subjects of Jesus Christ, owe to him, the only lawgiver and king in the church; who, as they say, hath expressly commanded that no power of this kind shall ever be claimed, or ever be yielded by any of his followers. In the prosecution of this mode of reasoning, they farther add, that if the church of England hath really this authority and right, the church of Rome had it before, and, as the elder and mother-church, ought to have been obeyed; and consequently the reformation, as it has been called, was a rebellion against superiors, a disobedience to the authority vested in the church, and ought, as such, to be renounced by returning to the church of Rome. They also argue, that this power to order the manner of God’s worship, and to settle articles of faith, is not at all lodged in the bishops or clergy, who are the spiritual pastors and guides in the established church, but entirely in the king and parliament of these realms. So far were the bishops and clergy from having any concern in the first forming our present established church,

or in ordering its rites and articles of faith, that it was done not only without, but in actual opposition to them. Hence they conclude, that the church of England is, in reality, a parliamentary church; that it is not, properly, an ally, as some have asserted, but a mere creature of the state. It depends entirely upon the acts and authority of parliament for its very essence and frame. The qualifications of its ministers, their power to officiate, the manner in which they are to administer the sacraments, are all limited and prescribed by authority of parliament; and this authority, which at first made, can alone alter and new-make it; can abolish, or add to its articles or rites, according to its pleasure, even though the whole body of bishops and clergy ever so much dislike or protest earnestly against it.

If it be asked, how came the civil magistrate to possess the authority which he exercises in the church of Christ? The objectors to establishments reply, that the subjection to higher powers, and obedience to magistrates, which the scriptures enjoin on Christians, relates only to civil, and not at all to religious matters, for this obvious reason, that the magistrate was at that time every where Pagan. They say, that Christianity is so far from enjoining, that it actually forbids, obedience to civil governors in things of a religious nature. It commands us "to call no man upon earth father or master" (Matt. xxiii. 8, 9.), *i. e.* to acknowledge no authority or jurisdiction of any in matters of religion, but to remember, that "one, one only is our master" and lawgiver, even Christ, and that all Christians are brethren: and that, though "the princes of the Gentiles exercise dominion over them, and they who are great exercise authority upon them, yet it shall not," says our Lord, "be so amongst you." (Matt. xx. 25.) Christ's kingdom is not of this world, and of course he is the sole lawgiver, judge, and sovereign in religious matters. (See Matt. xxiii. 8. xxviii. 18, 19. 1 Cor. viii. 6. Ephes. i. 22.) In the church of Christ, it is said, all authority and jurisdiction are vested originally in him, and flow from him, nor can any one lawfully exercise them without a commission from him; but in the church of England, the king, or queen, is "supreme head," possessing "all power to exercise all manner of ecclesiastical jurisdiction, and archbishops, bishops, archdeacons, and other ecclesiastical persons, have no manner of jurisdiction ecclesiastical, but by and under the king's majesty, who hath full power and authority to hear and determine all manner of causes ecclesiastical; and to reform and correct all vice, sin, errors, heresies, enormities, abuses whatsoever, which by any manner of spiritual authority or jurisdiction, ought, or may be lawfully reformed." (26 Hen. VIII. cap. 1. 37 Hen. VIII. cap. 17. 1 Eliz. cap. 1.) At the first establishment of this church under Henry VIII. and Edward VI. all the bishops took out commissions from the crown, for the exercising of their spiritual jurisdiction in these kingdoms, during the king's pleasure only; "and in their commissions acknowledge all sorts of jurisdiction, as well ecclesiastical as civil, to have flowed originally from the regal power, as from a supreme head, and a fountain and spring of all magistracy within his own kingdom." Burnet's Hist. Reform. part ii. Col. p. 92.

Yea, even the power of ordination itself, which is reckoned a peculiar of the episcopal office, the first reformers and founders of this church derived from the king, and exercised only as by authority from him, and during his pleasure. "Thus Craumer, archbishop of Canterbury, Bonner, bishop of London, &c. took out commissions from the crown, importing, that because the vicegerent (Cromwell, a lay person) could not personally attend the charge in all parts of the kingdom, the king authorises the bishop, in his, (the

king's or perhaps the vicegerent's) head to ordain, within his diocese, such as he judged worthy of holy orders; to collate to benefices; to give institution; and to execute all other parts of the episcopal authority; and this during the king's pleasure only."

In consequence of this supremacy, the king or queen of this church hath power to excommunicate from, or to readmit into it, independent of, yea, in direct opposition to, all its bishops and clergy. The king or queen revoke, if they please, any spiritual censures of the bishops or archbishops; yea, can suspend, deprive, or even excommunicate, themselves; or can, by their proclamation only, without the least confession, humiliation, or satisfaction for their offence, pardon and restore excommunicated persons, the vilest offenders, to the church's bosom again.

Yea, further, they have power to forbid all preaching for a time; as did king Henry VIII. king Edward VI. queen Mary, and queen Elizabeth; to limit, instruct, and prescribe to the clergy what they shall, and what they shall not preach; as did queen Elizabeth, king James I. king Charles I. king William, &c. Finally, to the king or queen only does it pertain to declare what is heresy, and authoritatively to pronounce what doctrines and tenets are, and what are not, to be censured as such: nor have all the bishops and clergy, assembled in convocation, the least authority to censure any tenet as heretical, if the prince on the throne refuse his consent.

Accordingly, the objectors to religious establishments allege, that in Christ's church, himself is the only sovereign and head; he only hath power to decree ceremonies and rites, to fix terms of communion and authority in points of faith; nor hath any earthly prince power to make laws in his kingdom, which shall bind the conscience of his subjects; or sovereignly to dictate to his servants and ministers what they shall believe, and what they shall preach. Yea, his subjects are expressly commanded and charged to receive nothing as doctrine or parts of religion, which are only commandments of men.

But in the church of England there is another sovereign, lawgiver, supreme head, besides Jesus Christ; an authority which commands things which Christ never commanded, which teaches doctrines he never taught, which enjoins terms of communion, and rites of religious worship, which Christ never enjoined. Hence they conclude, that these two churches are two distinct and quite different societies, framed after different models, consisting of different members, and governed by different officers, statutes, and laws. Whilst the objectors to established forms of worship esteem and reverence the great number of illustrious and excellent persons, both clergy and laity, of which the church of England can boast, they suggest, that the present established forms were drawn up when this kingdom just emerged out of Popish darkness; that in drawing them up special regard was had to the weakness of the people at that time, who could not be all at once entirely brought off from the old ceremonies and forms; and that there are several parts of our liturgy and ecclesiastical constitution, which even many of our bishops and clergy wish to see altered. Schemes have been proposed, and attempts have been made for omitting what is offensive, for correcting what is easily capable of amendment, and for accommodating the doctrine and forms of the established church, to the present advanced state of knowledge, and to the corresponding liberality of the modern professors of religion, both in and out of the church; but they have hitherto been unavailing: and it has been thought, that an exclusive establishment, appropriating to itself distinguished honours and benefits of a secular nature, and exposing those whom

whom it does not comprehend to privations, both of emolument and honour, has a tendency to discourage every effort for improving its constitution, and enlarging its boundaries. Some have also been of opinion that it restrains freedom of inquiry, embarrasses integrity, and too much disposes the uninstructed and uninformed to intolerance and persecution. From whom, it has been said, is a reform to be expected, but from those who have reason for wishing every thing to continue in statu quo? The dignitaries of the church, whose emoluments induce them to rest satisfied, and the ruling magistrates of the state, who wish things to remain quiet, and the great body of the laity, connected in one way or other with ecclesiastical establishments, cannot be supposed to be very anxious about a change in the constitution of the church: nor will they be at a loss for plausible reasons for resisting any material alteration. The church and the state are so incorporated, that nothing but a revolution, as it has been said, in the latter, would cause any very important amendment in the former. Nevertheless, reformers have maintained, that if the liturgy, clergy, articles, canons, with all the ceremonies and rites of the established church, were entirely vanished from the land; if its immense revenues were applied to ease our heavy taxes, and for the payment of the public debts; and if preachers were paid only by voluntary contributions; the state would not sustain so essential a loss and damage, that it could not thenceforward possibly subsist. Would, say they, the British monarchy be overthrown; our courts of judicature be shut up; the courts of law be stopped; parliaments no more meet; commerce and trade stagnate, because the national church was no more? On the contrary, however great the convulsion might be, the government, both civil and military, might remain the very same. A timely reformation, however, would, as they imagine, prevent its total destruction, and contribute to its permanence and prosperity.

Some notice should here be taken of the learned Warburton's famous argument in favour of an established church. The church, says this prelate, has, by contract or alliance, resigned her supremacy in matters ecclesiastical, and her independency, to the state. In consequence of this, the state hath drawn up for her articles of faith, and forms of public worship, which it requires the church to subscribe and use. This alliance is a mere phantom, created by the warm imagination of the paradoxical bishop, whose ingenuity and learning have not been sufficient to render it popular, even among the most zealous advocates of religious establishments. Neither our history nor our laws know any thing at all of it. The nature of our constitution utterly disavows it; and avows the church to be not an ally, but a subject to the state. An alliance supposes independency in the powers between which it subsists. But it is needless to enlarge on this topic.

Whilst it is allowed that religion has an influence on the conduct of men in this life, it is pleaded, on the other hand, that this beneficial influence of religion is promoted in all denominations of Christians, and as much in those which are reprobated by the state as in those which are encouraged by it. It has been also said, that the subject of religion is so interesting to the generality of mankind, that if government did not interfere, the contention about it would be so violent, that the public peace could not be preserved. To this argument in favour of establishments, it has been replied, that these contentions are much increased by the favour shewn to one mode of religion, and the opprobrium which is consequently thrown on the rest; and that, where temporal interest is not concerned, mere opinions will not occasion any

differences at which government need to be alarmed. Christianity was introduced and established, and subsisted for about three hundred years, without any favour or protection from the governing powers; and the example of America, in some provinces of which there is, strictly speaking, no establishment of religion, and in which numerous forms of religion are openly professed, serves to shew, that the want of an establishment is attended with no danger to the state. It is farther objected, that the state, by undertaking the care of religion, the truth and utility of which will, under providence, ensure its permanence, has taken upon itself a great, dangerous, and unnecessary burden; and from its jealousy of sectaries, often deprives itself of the services of some of its best and most able subjects; and at some times it has been induced to persecute and destroy them, because if they were left free, and even suffered to live, it was apprehended their principles might spread to the risk of the establishment. To the national establishment of our own country, the enlightened advocates of which abhor and discountenance intolerance and persecution, it has been objected, that it deprives the people of the choice of their own teachers and pastors; that it imposes subscription to creeds of doubtful evidence, and the observance of forms of questionable utility, on its own ministers; that it renders the support of them burdensome to those who avail themselves of their labours, and to others who derive no benefit from them; and that it excludes by obnoxious statutes a considerable class of loyal subjects from offices which they are competent to discharge, as well as emoluments and honours of which they have a right to participate. See *DISSENTERS*, *SUBSCRIPTION*, *TEST*, and *TYTHES*.

We now proceed to state the arguments that have been urged in favour of national establishments of religion; and we shall here avail ourselves of the reasoning of an excellent writer, who has done ample justice to the subject, and who, at the same time, has discussed it with a liberality and moderation, which have a tendency to conciliate those whose sentiments may be different from his own. "A religious establishment," he says, "is no part of Christianity; it is only the means of inculcating it." It cannot be proved, that any form of church government has been laid down in the Christian, as it had been in the Jewish scriptures, with a view of fixing a constitution for succeeding ages; and which constitution, consequently, the disciples of Christ would, every where, and at all times, by the very law of their religion, be obliged to adopt. Certainly no command for this purpose was delivered by Christ himself; and though the apostles ordained bishops and presbyters among their first converts, and appointed also deacons and deaconesses, investing them with functions different from any that now subsist, such offices were at first erected in the Christian church, as the good order, the instruction, and the exigencies of the society at that time required, without any declared design of regulating the appointment, authority, or distinction of Christian ministers under future circumstances. After this concession, our author founds the authority of a church establishment in its utility; and in judging of the comparative excellence of different establishments, he suggests, that the single view, under which we ought to consider any of them, is that of "a scheme of instruction," and the single end we ought to propose by them is, "the preservation and communication of religious knowledge." Every other idea, and every other end that have been mixed with this, as the making of the church an engine, or even an ally of the state; converting it into the means of strengthening, or of diffusing influence; or regarding it as a support of regal, in opposition to popular forms of government, have served only

to debase the institution, and to introduce into it numerous corruptions and abuses. The notion, says our author, of a religious establishment comprehends three things, a clergy, or order of men secluded from other professions to attend upon the offices of religion; a legal provision for the maintenance of the clergy; and the confining of that provision to the teachers of a particular sect of Christians. Without these, there exists no national religion, or established church, according to the sense which these terms are usually made to convey. He, therefore, who would defend ecclesiastical establishments, must shew the separate utility of these three essential parts of their constitution. Under the first head he maintains, that the knowledge and profession of Christianity cannot be maintained in a country without a class of men set apart by public authority to the study and teaching of religion, and to the conducting of public worship; and that for these purposes they should be precluded from other employments; and that of course they ought to derive a maintenance from their own. If they depended for this maintenance upon the voluntary contributions of their hearers, he is of opinion, that few would ultimately contribute any thing at all. To the consideration of the difficulty with which congregations would be established and upheld upon the *voluntary* plan, he adds, that of the condition of those who are to officiate in them. Preaching, he thinks, would in this case become a kind of begging; and the preacher, being at the mercy of his audience, would be obliged to adapt his doctrines, and also his style and manner of preaching, to the pleasure of a capricious multitude; and to live in constant bondage to tyrannical and insolent directors; which he could not do without a sacrifice of principle, and a depravation of character. Admitting these circumstances to be fairly stated, which perhaps an objector would reluctantly allow. Dr. Paley concludes, that a legal provision for the clergy, compulsory upon those who contribute to it, is expedient; and then proceeds to inquire, whether this provision should be confined to one sect of Christians, or extended indifferently to all. This question, it should be recollected, *can* never offer itself where the people are agreed in their religious opinions, and *ought* never to arise, where a system of doctrines and worship may be so framed as to comprehend their disagreements, and which might satisfy all by uniting all in the articles of their common faith, and in a mode of divine worship that omits every subject of controversy or offence. Where such a comprehension is practicable, the comprehending religion ought to be made that of the state. But where this comprehension is impracticable, and separate congregations and different sects must continue in the country, the question fairly recurs, whether, under such circumstances, the laws ought to establish one sect in preference to the rest; that is, whether they ought to confer the provision assigned to the maintenance of religion upon the teachers of one system of doctrines alone. This question is intimately connected with, and in a great measure dependent upon, another; and that is, in what way, or by whom, ought the ministers of religion to be *appointed*? In that species of patronage which subsists in this country, and which allows private individuals to nominate teachers of religion for districts and congregations, to which they are absolute strangers, some test should be proposed to the persons nominated, in order to prevent that discordancy of religious opinions that might otherwise arise between the several teachers and their respective congregations. The requisition of subscription, or any other test by which the national religion is guarded, may be considered merely as a restriction upon the exercise of private patronage. Wherefore, therefore, this constitution of patronage is adopted,

a national religion, or the legal preference of one particular religion to all others, must almost necessarily accompany it. If we suppose that the appointment of the minister of religion was in every parish left to the choice of the parishioner, might not this choice be safely exercised, without its being limited to the teachers of any particular sect? The effect, says our author, of such a liberty must be, that a Papist, or a Presbyterian, a Methodist, a Moravian, or an Anabaptist, would successively gain possession of the pulpit, according as a majority of the party happened at each election to prevail; and on every choice, it is apprehended, that violent conflicts would be renewed, and bitter animosities be revived. If the state appoint the ministers of religion, this constitution will differ little from the establishment of a national religion: for the state would undoubtedly appoint only those whose religious opinions, or rather whose religious denomination, agree with its own; unless it be thought that religious liberty would derive any advantage from transferring the choice of the national religion from the legislature of the country to the magistrate who administers the executive government. The only plan which seems to render the legal maintenance of a clergy practicable, without the legal preference of one sect of Christians to another, is that of an experiment which has been attempted (and which is said to have succeeded) in some of the new states of North America. The nature of the plan is thus described. A tax is levied upon the inhabitants for the general support of religion: the collector of the tax goes round with a register in his hand, in which are inserted, at the head of so many distinct columns, the names of the several religious sects that are professed in the country. The person who is called upon for the assessment, as soon as he has paid his quota, subscribes his name in which of the columns he pleases; and the amount of what is collected in each column is paid over to the minister of that denomination. In this scheme it is not left to the option of the subject, whether he will contribute, or how much he shall contribute, to the maintenance of a Christian minister: it is only referred to his choice to determine by what sect his contribution shall be received. The above arrangement, says Paley, is undoubtedly the best that has been proposed upon this principle; it bears the appearance of liberality and justice; and it may contain some solid advantages. But our author thinks that its inconveniences will be found to overbalance all its recommendations. It is scarcely compatible with the first requisite in an ecclesiastical establishment, which is the division of the country into parishes of a commodious extent. If the parishes be small, and ministers of every denomination be stationed in each, which the plan seems to suppose, the expence of their maintenance will become too burdensome a charge for the country to support. If, for reducing the expence, the districts be enlarged, the place of assembling will, in some cases, be too far removed from the residence of the persons who ought to resort to it. Besides, if the pecuniary success of the different teachers of religion be made to depend upon the number and wealth of their respective followers, this would naturally generate strifes and indecent jealousies amongst them, as well as produce a polemical and proselyting spirit, founded in or mixed with views of private gain; which would both deprave the principles of the clergy, and distract the country with endless contentions.

If it be expedient, says our author, to establish a national religion, that is, one sect in preference to all others, some *test*, by which the teacher of that sect may be distinguished from the teachers of different sects, appears to be an indispensable consequence. The existence of such an establishment

ment supposes it: the very notion of a national religion includes that of a test. But the necessity of a test has furnished to almost every church a pretence for extending, multiplying, and continuing such tests beyond what the occasion justified. For though some purposes of order and tranquillity may be answered by the establishment of creeds and confessions, yet they are at all times attended with serious inconveniences. They check inquiry; they violate liberty; they ensnare the consciences of the clergy, by holding out temptations to prevarication; and in process of time, they contradict the opinions of the church, whose doctrines they profess to contain; and they often perpetuate the proscription of sects and tenets, from which any danger has long ceased to be apprehended. Although tests and subscriptions may not be abolished, they should be made as easy and simple as possible. They should be adapted from time to time to the varying sentiments and circumstances of the church in which they are received; nor should they at any time advance one step farther than some subsisting necessity requires. Promises of conformity to the rites, liturgy, and offices of the church, if sufficient to prevent confusion in the celebration of divine worship, should be accepted in the place of stricter subscriptions. If any agreements, not to preach certain doctrines, nor to revive certain controversies, denominated articles of *peace*, would exclude indecent alterations amongst the national clergy, and also secure to the public teaching of religion as much of uniformity and quiet as is necessary to edification; then confessions of faith ought to be converted into articles of peace. In a word, it ought to be held, says Dr. Paley, a sufficient reason for relaxing the terms of subscription, or for dropping any or all of the articles to be subscribed, that no present necessity requires greater strictness.

It is a question that has been long agitated in the reformed churches of Christendom, whether a parity amongst the clergy, or a distinction of orders in the ministry, be more conducive to the general ends of the institution? Our author is inclined to the latter alternative, for reasons which he has stated.

In discussing the subject of a national establishment of religion, the right of the civil magistrate to interfere at all in matters of religion offers itself to consideration; and although this right may be acknowledged whilst he is employed solely in providing means of public instruction, it may be questioned whether he should inflict penalties, and impose restraints or incapacities on the account of religious distinctions. Our author, deducing the authority of civil government from the will of God, and inferring that will from public expediency alone, concludes that the jurisdiction of the magistrate is limited by no consideration but that of general utility; or that whatever be the subject demanding regulation, it is lawful for him to interfere, whenever his interference, in its general tendency, appears to be conducive to the common interest. Our author conceives, that there is nothing in the nature of religion, as *such*, which exempts it from the authority of the legislator, when the safety or welfare of the community requires his interposition. To the objection, that religion, pertaining to the interests of a life to come, lies beyond the province of the civil government, the office of which is confined to the affairs of this life, Dr. Paley replies, that when the laws interfere even in religion, they interfere only with temporals; their effects terminate, their power operates only upon those rights and interests, which confessedly belong to their disposal. He proceeds to observe, probably without satisfying the objector, "that the acts of the legislator, the edicts of the

prince, the sentence of the judge, cannot affect my salvation; nor do they, without the most absurd arrogance, pretend to any such power: but they may deprive me of liberty, property, and even of life itself, on account of my religion; and however I may complain of the injustice of the sentence, by which I am condemned, I cannot allege that the magistrate has transgressed the boundaries of his jurisdiction; because the property, the liberty, and the life of the subject, may be taken away by the authority of the laws, for any reason, which, in the judgment of the legislature, renders such a measure necessary to the common welfare. Moreover, as the precepts of religion may regulate all the offices of life, or may be so construed as to extend to all, the exemption of religion from the control of human laws might afford a plea, which would exclude civil government from every authority over the conduct of its subjects. Religious liberty is like civil liberty, not an immunity from restraint, but the being restrained by no law, but what in a greater degree conduces to the public welfare."

By way of qualifying this reasoning, which may be thought exceptionable, Dr. Paley observes, that "still it is right to obey God rather than man."—"When human laws interpose their direction in matters of religion, by dictating, for example, the object or the mode of divine worship; by prohibiting the profession of some articles of faith, and by executing that of others; they are liable to clash with what private persons believe to be already settled by precepts of revelation, or to contradict what God himself, they think, hath declared to be true. In this case, on whichever side the mistake lies, or whatever plea the state may allege to justify its edict, the subject can have none to excuse his compliance. The same consideration also points out the distinction, as to the authority of the state between temporals and spirituals. The magistrate is not to be obeyed in temporals more than in spirituals, where a repugnance is perceived between his commands, and any credited manifestations of the divine will; but such repugnancies are much less likely to arise in one case than in the other." The general proposition laid down by our author is as follows: "That it is lawful for the magistrate to interfere in the affairs of religion, whenever his interference appears to him to conduce, by its general tendency, to the public happiness." To others this proposition will appear to be in many respects exceptionable. The magistrate of course is to be the judge, what are the occasions in which he may interfere; and these occasions will occur whenever he pleases. Dr. Paley has therefore endeavoured to guard it against misapprehension and misapplication. Having stated, that it is the *general* tendency of the measure, or, in other words, the effects which would arise from the measure being *generally* adopted, that fixes upon it the character of rectitude or injustice, he then proceeds to inquire what is the degree and the sort of interference of secular laws in matters of religion, which are likely to be beneficial to the public happiness. In settling this point he premises two maxims; the first is, that any form of Christianity is better than no religion at all; and the second is, that of different systems of faith, that is the best which is the truest. From the first proposition it is inferred, that when the state enables its subjects to learn *some* form of Christianity by distributing teachers of a religious system throughout the country, and by providing for the maintenance of these teachers at the public expence; that is, when the *laws* establish a national religion, they exercise a power and interference, which are likely, in their general tendency, to promote the interest of mankind.

But after the right of the magistrate to establish a particular religion has been, upon this principle, admitted; a doubt arises, whether the religion he ought to establish be that which he himself professes, or that which he observes to prevail amongst the majority of the people. Assuming it to be an equal chance, which of the two religions, that of the magistrate or that of the people, contains more of truth, it becomes a consideration of some importance, to which arrangement we may attach the greater efficacy; that of an order of men appointed to teach the people their own religion, or to convert them to another; and as in our author's opinion the advantage lies on the side of the former scheme, it becomes the duty of the magistrate, in the choice of the religion which he establishes, to consult the faith of the nation rather than his own. For our author's reasoning on other topics connected with a national establishment of religion, we refer to the articles SUBSCRIPTION, TEST, and TOLERATION. He closes the discussion of the general subject with the following summary of his argument: the result of our examination of those general tendencies, by which every interference of civil government in matters of religion ought to be tried, is this: "That a comprehensive national religion, guarded by a few articles of peace, and conformity, together with a legal provision for the clergy of that religion; and with a complete toleration of all dissenters from the established church, without any other limitation or exception, than what arises from the conjunction of dangerous political dispositions with certain religious tenets, appears to be, not only the most just and liberal, but the wisest and safest system, which a state can adopt: inasmuch as it unites the several perfections, which a religious constitution ought to aim at—liberty of conscience, with means of instruction; the progress of truth, with the peace of society; the right of private judgment, with the care of the public safety." Paley's *Principles of Moral and Political Philosophy*, vol. ii. ch. 10.

In most countries where religion is established, it is that of the majority of the people; and on this principle the writers in defence of ecclesiastical establishments vindicate them. But in a part of the united kingdom of Great Britain, *viz.* in Ireland, we have a remarkable exception to this rule. There the established religion is not that of the majority, but of a small minority of the people. Ever since the reformation the members of the church of England have kept possession of the tithes of the whole island, where they have long despaired of bringing the people over to that religion for which they pay so dear.

In connection with the national establishment of religion we shall here remark, that in this country the care which government takes of religion extends itself to the business of education, confining the universities, which are supported by the national funds, to the education of the members of the church of England, and rigorously excluding all sectaries, either by requiring subscription to the thirty-nine articles at the time of matriculation, or of taking certain degrees, or obliging the students to attend the service of the established church, and to declare that they are *bona fide* members of it.

Among the offences against religion enumerated by judge Blackstone, and punishable by the laws of England, are *apostacy* and *heresy*, which see respectively; and also those which affect the established church. These latter are either positive or negative; positive by reviling its ordinances, or negative, by non-conformity to its worship. See REVILING, &c. COMMON Prayer, NON-CONFORMISTS, DISSENTERS,

PAPISTS, and POPERY. See also BLASPHEMY, PROFANENESS, CONJURATION and WITCHCRAFT, Religious IMPOSTORS, SUNDAY, False PROPHECIES, DRUNKENNESS, LEWDNESS, and SIMONY.

RELIGION, again, is applied to a military order, consisting of knights who live under some certain rule, &c.

In this sense we say, the religion of Malta, &c. See MALTA.

RELIGION is sometimes also used for a convent. Thus, we say, there are religions of men, *i. e.* monks; religions of women, *i. e.* nuns.

RELIGION, *The*, used absolutely, denotes the Reformed in France. Thus, they say, d'Ablancourt and Dacier were of the religion. See HUGUENOTS.

RELIGIOUS, in a general sense, something that relates to religion.

We say, a religious life, religious society, &c. Churches and church-yards are religious places. A religious war is also called a *croisade*; which see.

RELIGIOUS is more particularly used for a person engaged by solemn vows to the monastic life; or a person shut up in a monastery, to lead a life of devotion and austerity, under some rule or institution.

The male religious we popularly call *monks* and *friars*; the female, *nuns* and *canonesses*. See CANON, MONK, NUN, &c.

M. Nicole observes, that some domestic chagrins, and a certain pride, which leads people to abscond when they cannot make a figure to their mind, make as many religious as real piety. He adds, that a girl must often be made a religious for no other reason, but because she cannot be married answerable to her condition.

Great influence, however, may be attributed to enthusiasm and superstition, and to those mistaken notions of duty and of perfection of character, which have often originated in these sources, and which have produced effect on honest minds of a peculiar temperament and disposition. Whilst no kind of argument can justify this retirement from the world, and total seclusion from the occupations and pleasures of social life, it would manifest a want of candour as well as ignorance of human nature indiscriminately to condemn all who have devoted themselves to such a kind of indolent and useless life.

A religious cannot make any will. By the council of Trent, a religious may reclaim his vows within five years.

Anciently the religious were all laymen, and it was even prohibited them to take up orders. In 1557, the parliament of Paris made a difficulty of receiving a bishop of Laon to the oath of a duke and peer, by reason of his being a religious: yet a religious, being promoted to a bishopric, is thenceforth secularized or dispensed from the observation of his rule.

In ancient deeds and conveyances of lands, we often find the seller restrained from giving or alienating it, *visis religiosis, vel Judeis*, to religious, or to Jews; to the end the land might not fall into *mortmain*; which see.

In a memorial directed by king John to his viscounts, they are ordered to proclaim through their respective counties, that nobody, as they love their bodies and cattle, injure the religious or clerks, either in word or deed, on penalty of being hanged up on the next oak. "Nulli, sicut diligunt corpora et catalla sua, malum faciant vel dicant visis religiosis vel clericis. Si quem inde attingere possimus, ad proximam quercum eum suspendi faciemus."

RELIGIOUS Houses, denote houses set apart for religious purposes,

purposes, such as monasteries, churches, hospitals, and all other places where charity is extended to the relief of the poor and orphans, or for the use or exercise of religion. See "Notitia Monastica," or "A short History of the religious Houses in England and Wales," by Tanner, 8vo.; in which, according to the alphabetical order of counties, is accurately given a full account of the founders, the time of foundation, tutelar saints, the order, the value, and the dissolution; with reference to printed authors and MSS. which preserve any memoirs relating to each house; with a preface of the institution of religious orders. Cowel.

RELIGIOUS *Impostors*. See IMPOSTORS.

RELIGIOUS *Order*. See ORDER.

Most military orders pretend likewise to be religious; as those of Malta, who make vows, &c. See MALTA.

RELINQUISHMENT, in *Law*, is a forsaking, abandoning, or giving over. It hath been adjudged, that a person may relinquish an ill demand in a declaration, &c. and have judgment for that which is well-demanded.

RELIQUA, the remainder or debt, which a person finds himself debtor in, upon the balancing or liquidating an account.

Hence *religuitary*, the debtor of a reliqua; as also a person who only pays piece-meal.

The term reliqua is pure Latin.

RELIQUE, RELICS, in *Antiquity*, the ashes and bones of the dead, which remained after burning their bodies; and which they very religiously gathered, and put into urns, and afterwards deposited in tombs. See RELICS.

RELIQUARY, a shrine or casket, in which the relics of a dead saint are kept.

RELIQUE. See RELICS.

RELIQUIA, in *Natural History*, a term used to express the fossil remains of certain substances found in different parts of the earth. In the article PETRIFICATIONS we have given the Linnæan division of the fifth class of minerals, and a pretty full description of the eight genera into which it is divided. In this place we shall present our readers with a very brief view of Mr. Martin's "Systema Reliquiorum." He considers the regnum fossilis, or fossil kingdom, to be divided into five classes, *viz.*

- I. Reliquia, or fossil remains from animals or plants.
- II. Terræ, earths.
- III. Salia, salts.
- IV. Inflammabilia, inflammable substances.
- V. Metalla, metallic substances.

The reliqua he divides into two orders, *viz.* *animal* and *vegetable* remains: of the former he gives eight genera; of the latter only one genus, which are as follow:

Order I. RELIQUIA ANIMALIA.

Innata.

- Genus 1. Mammodolithus, or remains of Mammalia.
 2. Ornitholithus, - - - Birds.
 3. Amphibiolithus, - - - Amphibia.
 4. Ichthyolithus, - - - Fishes.
 5. Entolithus, - - - Insects.
 6. Helmintholithus, of the parts of worms not fabricated.

Fabricata.

7. Conchyliothus, or remains of Testacea.
 8. Erismatolithus, of fulciments, or fabricated supports of worms.

Order II. RELIQUIA VEGETALIA.

9. Phytolithus, the remains of Plants.

Mr. Martin has given certain fundamental principles, on which he conceives the study of reliqua may be scientifically conducted: these are as follow.

1. All natural bodies without life found on or beneath the surface of the earth, and which are not susceptible of putrefaction, belong to the fossil kingdom, and are either reliqua or minerals. Fossils are usually denominated "bodies destitute of an organic structure:" now though it be admitted that all fossils are, according to the common acceptance of the term, unorganized, they are not destitute of the structure which distinguishes an organized body. This being admitted, it follows that a line must be drawn between animal and vegetable matter recently buried in the earth, and which has acquired a genuine fossil character. This line will depend perhaps on putrefaction, to which even organic substances, after they have become fossil, are no longer subject.

2. An organic structure, whether of a plant or animal, is the essence of an extraneous fossil or reliquium. By this alone it is characterized, or distinguished from a mineral.

3. It is the organic form alone on which the arrangement of reliqua must be founded. Every system of natural bodies should assume for its basis but one principle, and this should be drawn from the most essential characteristics of the bodies under arrangement. It is on this account the form is pointed out as furnishing the only genuine principle, on which the classification of reliqua can be established.

4. The primary divisions of the arrangement, *viz.* orders, genera, &c. should agree with such natural divisions of plants and animals as are determinable by the form of the fossil subjects.

5. The specific differences in reliqua depend on the specific differences of form in the original bodies. One species of plant or animal can give but one real or genuine species of extraneous fossil. For if the essence of the reliquium be an organic form, its other affections, arising from substance, mode, and soil, are accidental, and cannot be used as specific distinctions, which must always depend on something essential to the body which we wish to discriminate. *Form*, therefore, must furnish specific differences of reliqua, and it of course follows that there will be as many genuine species of reliqua, as there are genuine specific forms in the animal and vegetable prototypes or originals: and that the number of fossil species are not increased by a separation of parts, or other accidental circumstances to which the original bodies may have been subjected during their change into fossils.

6. Specific distinctions of reliqua being founded only on the organic form, it follows, that their geological and mineralogical affections, with their modal diversities, merely characterize specimens.

7. The specific descriptions of reliqua are to be given according to the principles of botany and zoology. Those of the specimens, according to the principles of mineralogy and geology. The *essential* form of the reliquium must be distinguished from the *accidental*, that is, the form of the original body, from that which has arisen in the fossil from the mode of mineralization, the constituent substance, and the soil of the specimen.

8. The nomenclature of reliqua should manifest the extent of the present state of knowledge with respect to the original bodies.

To what has been said, we shall add an account of our author's "Delineations of Reliquia."

The leading parts in the delineation of a reliquium are

RELIQUIA.

the specific character or diagnosis, and the general description.

The *specific character* contains the marks that distinguish the species to which they belong, from all others in the same genus. Specific characters of reliquia should be so constructed as to distinguish permanent from temporary species; and those whose originals have not, as yet, been discovered. The specific character of the recent species of plants or animals frequently depends on parts often or constantly wanting in the fossil subject. When that is the case, another diagnosis must be given to distinguish the reliquium; that of the recent species being marked as a parenthesis. The generic and trivial names are prefixed to the specific character. And, generally, the name of the family, or subdivision of the genus to which the reliquium belongs: after which is to be detailed in distinct classes, 1. The synonyms or names by which the species has been distinguished by authors, with references to the figures given of it. 2. The varieties of the species, with their synonyms. 3. The vernacular name. 4. The mode or state in which the reliquium is found. 5. Its soil or geological situation. 6. Its geographic situation, and then the general description.

The description delineates in appropriate terms all the parts constituting the essential form of the reliquium, according to their number, figure, proportion, and situation: it must primarily refer to the original of the reliquium, as no just or perfect delineation of the species can be given, until the nature of its prototype be ascertained.

The terms employed in describing reliquia, which derive their form from the external parts of animals and plants, must be those used by zoologists and botanists of the Linnæan school. But those which derive their form from the internal parts of organic bodies, are to be described in such terms as anatomists would use in distinguishing the same parts in the recent subjects.

As appendant parts to the general description of the reliquium must be given, 1. An enumeration of the specimens which exhibit the various accidental forms under which the species has been found. 2. An enumeration of the various substances which have been observed as constituting the reliquium and its matrix.

Having given this brief account of Mr. Martin's scientific delineations of reliquia, we shall present our readers with the substance of two very interesting communications sent to the Royal Society since the printing of the article *PETRI-FACTIONS*. Of these, the first is "An Account of some Organic Remains found by Mr. Trimmer, near Brentford, in Middlesex."

"The specimens," says Mr. Trimmer, "have been collected from two fields, not contiguous to each other; therefore, to avoid confusion, I shall take each field separately, first describing the strata as far as they have come within my knowledge, and afterwards I shall speak of the organic remains as they were respectively found in those strata."

"The first field is about half a mile north of the Thames at Kew bridge; its surface is about twenty-five feet above the Thames at low water. The strata here are, first, sandy loam from six to seven feet, the lowest two feet slightly calcareous. Second, sandy gravel, a few inches only in thickness. Third, loam slightly calcareous, from one to five feet: between this and the next stratum, peat frequently intervenes in small patches, of only a few yards wide, and a few inches thick. Fourth, gravel containing water; this stratum varies from two to ten feet in thickness, and is always the deepest in the places covered by peat; in these places the lower part of the stratum becomes an heterogeneous mass of clay, sand, and gravel, and frequently

exhales a disagreeable muddy smell. Fifth, the main stratum of blue clay, which lies under this, extends under London and its vicinity; the average depth of this clay has been ascertained, by wells that have been dug through it, to be about two hundred feet under the surface of the more level lands, and proportionally deeper under the hills, as appears from lord Spencer's well at Wimbledon, which is five hundred and sixty-seven feet deep. This stratum, besides figured fossils, contains pyrites and many detached nodules; at the depth of twenty feet there is a regular stratum of these nodules, some of which are of very considerable size.

"In the first stratum, as far as my observation has extended, no remains of an organized body has ever been found, and as my search has not been very limited, I may venture to say it contains none. In the second stratum, snail-shells, and the shells of river-fish, have been found, and a few bones of land animals, but of inconsiderable size, and in such a mutilated state, that it cannot be ascertained to what class they belong. In the third stratum, the horns and bones of the ox, and the horns, bones, and teeth of the deer, have been found, and also, as in the second stratum, snail-shells, and the shells of river-fish. In the fourth stratum were found teeth and bones of both the African and Asiatic elephants, teeth of the hippopotamus, bones, horns, and teeth of the ox.

"A tusk of an elephant measured, as it lay on the ground, nine feet three inches, but, in attempting to remove it, it broke into small pieces. When this stratum dips into the clay, and becomes a mixed mass, as before stated, it is seldom without the remains of animals. In the fifth stratum, namely, the blue clay, the extraneous fossils are entirely marine, with the exception of some specimens of fruit and pieces of petrified wood, the latter of which may be considered as marine, because, when of sufficient size, they are always penetrated by teredines. The other fossils from this stratum are nautili, oysters, pinnæ marinæ, crabs, teeth and bones of fish, and a great variety of small marine shells; this stratum has been penetrated hitherto in this field only to the depth of thirty feet, throughout which the specimens found were dispersed without any regularity.

"The second field is about one mile to the westward of the former, one mile north of the Thames, and a quarter of a mile to the eastward of the river Brent; its height above the Thames, at low water, is about forty feet. The strata are, first, sandy loam, eight or nine feet, in the lowest three feet of which it is slightly calcareous. Second, sand, becoming coarser towards the lowest part, and ending in sandy gravel from three to eight feet. Third, sandy loam highly calcareous, having its upper surface nearly level, but gradually increasing in thickness from a feather-edge to nine feet. Below this are two strata of gravel and clay, as in the other field; but as these strata have been only occasionally penetrated in digging for water, nothing therefore is known with respect to them, but that they exist there.

"In the first stratum, as in the other field, no organic remains have been observed. In the second, but always within two feet of the third stratum, have been found the teeth and bones of the hippopotamus, the teeth and bones of the elephant, the horns, bones and teeth of several species of deer, the horns, bones and teeth of the ox, and the shells of river-fish.

"The remains of hippopotami are so extremely abundant, that, in turning over an area of 120 yards in the present season, parts of six tusks have been found of this animal, besides a tooth and part of the horn of a deer, part of a tusk, and part of a grinder of an elephant, and the horns, with a small part of the skull, of an ox. One of these horns I had

an opportunity of measuring as it lay on the ground, and found it to be $4\frac{1}{2}$ feet in length, and five inches in diameter at the large end; it was found impracticable to remove it, otherwise than in fragments, which I have preserved, and have hopes of being able to put a considerable part of it together. The immense size of this horn is rendered more remarkable by another horn from the same spot, which measures but six inches in length. Though this stratum is so extremely productive of the remains of animals, yet there are but few good cabinet specimens from it, owing, it is presumed, to their having been crushed at the time they were buried, and to the injury they have since received from moisture. It is necessary to remark, that the gravel-stones in this stratum do not appear to have been rounded in the usual way by attrition, and that the bones must have been deposited after the flesh was off, because, in no instance, have two bones been found together which were joined in the living animal; and further, that the bones are not in the least worn, as must have been the case had they been exposed to the wash of a sea-beach.

"In the third stratum, *viz.* calcareous loam, have been found the horns, bones and teeth of the deer, the bones and teeth of the ox, together with snail-shells, and the shells of river-fish.

"Brentford, in the neighbourhood of which are the fields I have mentioned, is situated on the north bank of the Thames, and is six miles west of London.

"The fall of the Thames from Brentford to its mouth at the Nore, is estimated at seven feet."

The next communication is in relation to a fossil human skeleton, found imbedded in lime-stone lately brought from the island of Guadaloupe by the honourable sir Alexander Cochrane, and presented by the admiralty to the British Museum. Of this highly curious specimen Mr. Konig has given an account that, to naturalists, will be regarded as highly important and interesting.

"On the history of the strata produced by the more recent catastrophes of the globe," says Mr. Konig, "most light has been thrown by the indefatigable exertions of M. Cuvier. Superlatively skilled in comparative anatomy, this gentleman has succeeded in determining the fossil bones of no less than 78 species, of which 49 are entirely unknown among the existing races of animals; about 12 are identified with known species, and the remainder strongly resemble existing species, although their identity has not been completely ascertained. From the multiplied observations which this naturalist has communicated in his numerous memoirs, we may gather that the viviparous quadrupeds appear at a much later period in the fossil state than the oviparous; the latter being probably coeval with the fishes, whilst the former are found only in the newest formations, in which, according to Brongniart and Cuvier's interesting discovery, marine beds are observed to alternate with those of fresh water, and which (in the neighbourhood of Paris) overlay the coarse shell lime-stone, which constitutes the last strata formed, as it would appear, by a long and quiet stay of the sea on our continent.

"All the circumstances under which the known depositions of bones occur, both in alluvial beds and in the caverns and fissures of flint lime-stone, tend to prove, that the animals to which they belonged met their fate in the very places where they now lie buried. Hence, it may be considered as an axiom, that man, and other animals, whose bones are not found intermixed with them, did not co-exist in time and place. The same mode of reasoning would further justify us in the conclusion, that, if those catastrophes which overwhelmed a great proportion of the brute creation were general, as

geognostic observations in various parts of the world render probable, the creation of man must have been posterior to that of those genera and species of mammalia which perished by a general cataclysm, and whose bones are so thickly disseminated in the more recent formations of rocks.

"The human skeletons from Guadaloupe are called Galibi by the natives of that island; a name said to have been that of an ancient tribe of Caribs of Guiana, but which, according to a plausible conjecture, originated in the substitution of the letter *l* instead of *r*, in the word Caribbee. No mention is made of them by any author except general Ernouf, in a letter to M. Faujas St. Fond, inserted in vol. v. (1805) of the *Annales du Muséum*; and by M. Lavaisse, in his *Voyage à la Trinidad*, &c. published in 1813. The former of these gentlemen writes, that, on that part of the windward side of the Grande-Terre, called La Moule, skeletons are found enveloped in what he terms "*Masses de madrépores pétrifiées*," which being very hard, and situated within the line of high water, could not be worked without great difficulty, but that he expected to succeed in causing some of these masses to be detached, the measurements of which he states to be about eight feet by two and a half.

"The block brought home by sir Alexander Cochrane exactly answered this account with regard to the measurements; in thickness it was about a foot and a half. It weighed nearly two tons; its shape was irregular, approaching to a flattened oval, with here and there some concavities, the largest of which, as it afterwards appeared, occupying the place where the thigh-bone had been situated, the lower part of which was therefore wanting. Except the few holes evidently made to assist in raising the block, the masons here declared, that there was no mark of a tool upon any part of it; and, indeed, the whole had very much the appearance of a huge nodule disengaged from a surrounding mass.

"The situation of the skeleton in the block was so superficial, that its presence in the rock on the coast had probably been indicated by the projection of some of the more elevated parts of the left fore-arm.

"The skull is wanting; a circumstance which is the more to be regretted, as this characteristic part might possibly have thrown some light on the subject under consideration, or would, at least, have settled the question, whether the skeleton is that of a Carib, who used to give the frontal bone of the head a particular shape by compression; which had the effect of depressing the upper, and protruding the lower edge of the orbits, so as to make the direction of their opening nearly upwards, or horizontal, instead of vertical.

"The vertebrae of the neck were lost with the head. The bones of the thorax bear all the marks of considerable concussion, and are completely dislocated. The seven true ribs of the left side, though their heads are not in connection with the vertebrae, are complete; but only three of the false ribs are observable. On the right side only fragments of these bones are seen; but the upper part of the seven true ribs of this side are found on the left, and might at first sight be taken for the termination of the left ribs. The right ribs must, therefore, have been violently broken, and carried over to the left side, where, if this mode of viewing the subject be correct, the sternum must likewise lie concealed below the termination of the ribs. The small bone dependent above the upper ribs of the left side, appears to be the right clavicle. The right os humeri is lost; of the left nothing remains except the condyles in connection with the fore-arm, which is in the state of pronation; the radius of this side exists nearly in its full length, while of the ulna the lower part only remains, which is considerably pushed upwards. Of the two bones of the right fore-arm, the inferior terminations

tions are seen. Both the rows of the bones of the wrists are lost, but the whole metacarpus of the left hand is displayed, together with part of the bones of the fingers: the first joint of the fore-finger rests on the upper ridge of the os pubis, the two others, detached from their metacarpal bones, are propelled downwards, and situated at the inner side of the femur, and below the foramen magnum ischii of this side. Vestiges of three of the fingers of the right hand are likewise visible, considerably below the lower portion of the fore-arm, and close to the upper extremity of the femur. The vertebræ may be traced along the whole length of the column, but are in no part of it well defined. Of the os sacrum, the superior portion only is distinct: it is disunited from the last vertebra and the ilium, and driven upwards. The left os ilium is nearly complete; but shattered, and one of the fragments depressed below the level of the rest: the ossa pubis, though well defined, are gradually lost in the mass of the stone. On the right side the os innominatum is completely shattered, and the fragments are sunk; but towards the acetabulum, part of its internal cellular structure is discernible.

"The thigh-bones and the bones of the leg of the right side are in good preservation, but being considerably turned outwards, the fibula lies buried in the stone, and is not seen. The lower part of the femur of this side is indicated only by a bony outline, and appears to have been distended by the compact lime-stone that fills the cavities both of the bones of the leg and thigh, and to the expansion of which these bones probably owe their present shattered condition. The lower end of the left thigh-bone appears to have been broken and lost in the operation of detaching the block; the two bones of the leg, however, on this side are nearly complete: the tibia was split almost the whole of its length a little below the external edge, and the fissure being filled up with lime-stone, now presents itself as a dark-coloured straight line. The portion of the stone which contained part of the bones of the tarsus and metatarsus was unfortunately broken; but the separate fragments are preserved.

"The whole of the bones, when first laid bare, had a mouldering appearance, and the hard surrounding stone could not be detached, without frequently injuring their surface; but, after an exposure for some days to the air, they acquired a considerable degree of hardness. Sir H. Davy, who subjected a small portion of them to chemical analysis, found that they contained part of their animal matter, and all their phosphate of lime. Here follows an exact description of the rock, in which the fossil skeleton is found. The attention of geologists being now directed towards this object, it may be expected that a scientific examination of the circumstances under which this lime-stone occurs, will not fail ere long to fix its age, and assign to it the place it is to occupy in the series of rocks. All our present information respecting the Grande Terre of Guadeloupe amounts to this, that it is a flat lime-stone country, derived principally from the detritus of zoophytes, with here and there single hills (mornes) composed of shell lime-stone; while Guadeloupe, properly so called, separated from the upper part by a narrow channel of the sea, has no traces of lime-stone, and is entirely volcanic."

M. Lavoisier, alluded to above as the only author who mentions the galibies, except general Ernouf, speaks of the bed of lime-stone which incloses them, as the most remarkable of the calcareous rocks in the Leeward islands. Mr. Konig, therefore, expected to find in his work an exact statement of its mode of occurring; but the only positive information he could collect from this author is, that the bed is a kilomètre (nearly an English mile) in length, and

that it is covered by the sea at high water. According to him, no trace of shells or organized bodies is discoverable in this rock; but in lieu of these, he was fortunate enough to meet with mortars, pestles, hatchets, &c. of a basaltic or porphyritic rock, which, we are informed, were petrified (petrified). From this very vague account, we should not be induced to lay much stress upon the circumstance that the position of the skeletons is east-west, and that the spot must, therefore, have been a cemetery, which time and circumstances have transformed into a hard calcareous rock.

"I have to apologise for this long letter on a subject," concludes Mr. Konig, "which may turn out to be interesting only so far, as the human bones from Guadeloupe are unquestionably the only bones we are acquainted with that have ever been found imbedded in a hard stony mass, that does not appear to belong to common stalactitical calcareous depositions. This circumstance admits of being easily ascertained by a close inspection of the locality; and I am perfectly of opinion, that a comparison of the nature of the different varieties of shell-sand, with which the neighbourhood of the Caribbee islands abounds, would alone be sufficient to remove many doubts relative to the origin of the bed in question. The sand from thence, which I had an opportunity of seeing, was unlike that of which the stone is composed."

RELL, MOUSE, in *Zoology*, the English name of the white-bellied mouse, with a blackish back and long body. See MYOXUS and GLIS.

RELLING, in *Geography*, a town of the duchy of Holstein; 2 miles S.S.E. of Pinnenberg.

RELLINGEN, a town of France, in the department of the Moselle, and chief place of a canton, in the district of Thionville. The place contains 602, and the canton 9046 inhabitants, on a territory of 212½ kilometres, in 36 communes.

RELLINGHAUSEN, a town of Germany, lately belonging to the abbey of Corvey; 16 miles N.N.E. of Dusseldorf.

RELLINGHUSEN, a town of the duchy of Holstein; 9 miles E. of Itzehoe.

REM, *Information in, in Law*. See INFORMATION.

REMAGEN, in *Geography*, a town of France, in the department of the Rhine and Moselle, and chief place of a canton, in the district of Bonn. The place contains 790, and the canton 7801 inhabitants, in 37 communes.

REMAIGHIAN, a town of Persia, in the province of Laristan; 10 miles N.W. of Tarem.

REMAINDER, REMANENTIA, in *Law*, an estate limited to take effect and be enjoyed after another estate is determined. As if a man seised in fee-simple granteth lands to A for twenty years, and, after the determination of the said term, then to B and his heirs for ever: here A is tenant for years, remainder to B in fee. In the first place, an estate for years is created or carved out of the fee, and given to A; and the residue or remainder of it is given to B. But both these interests are in fact only one estate; the present term of years and the remainder afterwards, when added together, being equal only to one estate in fee. (Co. Litt. 143.) Thus, also, if land be granted to A for twenty years, and after the determination of the said term to B for life; and after the determination of B's estate for life, it being limited to C and his heirs for ever; this makes A tenant for years, with remainder to B for life, remainder over to C in fee. In this case also, the first estate, and both the remainders, for life and in fee, are one estate only. Hence it is easy to infer, that no remainder can be limited after the grant of an estate in fee-simple (Plowd. 29.

Vaugh. 269.) ; because this is the highest and largest estate that a subject is capable of enjoying ; and he that is tenant in fee, hath in him the whole of the estate : a remainder, therefore, which is only a portion, or residuary part of the estate, cannot be reserved after the whole is disposed of.

The rules that are laid down by law to be observed in the creation of remainders, are as follow. 1. There must necessarily be some particular estate, precedent to the estate in remainder ; which particular estate is said to support the remainder. (Co. Litt. 49. Plowd. 25.) 2. The remainder must commence or pass out of the grantor, at the time of the creation of the particular estate (Litt. § 671. Plowd. 25.) : as where there is an estate to A for life, with remainder to B in fee ; here B's remainder in fee passes from the grantor at the same time that seisin is delivered to A of his life-estate in possession. And it is this which induces the necessity at common law of livery of seisin being made on the particular estate, whenever a freehold remainder is created. (Litt. § 60. Co. Litt. 49.) 3. The remainder must vest in the grantee during the continuance of the particular estate, or *eo instanti* that it determines. (Plowd. 25. 1 Rep. 66.) As if A be tenant for life, remainder to B in tail : here B's remainder is vested in him, at the creation of the particular estate to A for life : or if A and B be tenants for their joint lives, remainder to the survivor in fee ; here, though during their joint lives the remainder is vested in neither, yet on the death of either of them, the remainder vests instantly in the survivor ; whence both these are good remainders. But if an estate be limited to A for life, remainder to the eldest son of B in tail, and A dies before B hath any son ; here the remainder will be void, for it did not vest in any one during the continuance, nor at the determination, of the particular estate : and even supposing that B should afterwards have a son, he shall not take by this remainder ; for, as it did not vest at or before the end of the particular estate, it never can vest at all, but is gone for ever. (1 Rep. 138.) Hence remainders are either *vested* or *contingent*. *Vested* remainders (or remainders executed, by which a present interest passes to the party, though to be enjoyed in *future*) are such where the estate is invariably fixed, to remain to a determinate person after the particular estate is spent. As if A be tenant for twenty years, remainder to B in fee ; here B's is a *vested* remainder, which nothing can defeat or set aside. *Contingent* or executory remainders (by which no present interest passes) are where the estate in remainder is limited to take effect, either to a dubious and uncertain person, or upon a dubious or uncertain event ; so that the particular estate may chance to be determined, and the remainder never take effect. (3 Rep. 20.) In the first case, if A be tenant for life, with remainder to B's eldest son (then unborn) in tail, this is a contingent remainder, because it is uncertain whether B will have a son or not ; and if A dies before B's son is born, the remainder is absolutely gone ; even though A leaves his wife big with child, and after his death a posthumous son is born. (Salk. 228. 4 Mod. 282.) But to remedy this hardship, it is enacted by statute 10 & 11 W. III. cap. 16. that posthumous children shall be capable of taking in remainder, in the same manner as if they had been born in their father's life-time ; that is, the remainder is allowed to vest in them, while yet in their mother's womb. This species of contingent remainder, to a person not in being, must, however, be limited to some one, that may by common possibility, or *potentia propinqua*, be in *esse* at or before the particular estate determines. (2 Rep. 51.) A remainder to a man's eldest son, who has none, is good ; because by common possibility he may have one : but if it be

limited in particular to his son John or Richard, it is bad, if he have no son of that name ; for it is too remote a possibility, that he should not only have a son, but the son of a particular name. (5 Rep. 51.) A limitation of a remainder to a bastard before he is born, is not good (Cro. Eliz. 505.) ; for though the law allows the possibility of having bastards, it presumes it to be a very remote and improbable contingency. In the second case, where land is given to A for life, and in case B survives him, then with remainder to B in fee : here B is a certain person, but the remainder to him is a contingent remainder, depending upon the uncertainty of his surviving A. During the joint lives of B and A, it is contingent ; and if B dies first, it can never vest in his heirs, but is for ever gone ; but if A dies first, the remainder to B becomes vested. Contingent remainders of either kind, if they amount to a freehold, cannot be limited on an estate for years, or any other particular estate, less than a freehold. Thus, if land be granted to A for ten years, with remainder in fee to the right heirs of B, this remainder is void (1 Rep. 130.) ; but if granted to A for life, with a like remainder, it is good. Contingent remainders may be defeated, by destroying or determining the particular estate upon which they depend, before the contingency happens, by which they become vested. 1 Rep. 66. 155.

In devises by last will and testament, remainders may be created in some measure contrary to the rules here laid down : though our lawyers will not allow such dispositions to be strictly remainders ; but call them by another name, that of executory devises, or devises hereafter to be executed. Blackst. Com. book ii. chap. 11. § 3.

Spelman makes the difference between a remainder and reversion to consist in this ; that by a reversion, after the appointed term, the estate returns to the donor, or his heirs, as the proper fountain ; whereas by remainder it goes to some third person or stranger.

Or, a remainder is an expectancy, created by act of the parties ; whereas a reversion is created by act of law.

The limitations of personal goods and chattels, in remainder after a bequest for life, are permitted in last wills and testaments : so that if a man, either by deed or will, limits his books or furniture to A for life, with remainder over to B, this remainder is good. But where an estate-tail in things personal is given to the first or any subsequent possessor, it vests in him the total property, and no remainder over shall be permitted on such a limitation. 1 P. Wms. 290.

Glanville observes, that bishops and abbots, in regard their baronies are the king's alms, cannot give any part of them by way of remainder.

REMAINDER, *Writ of formedon in the*. See FORMEDON.

REMAINDER, in *Mathematics*, is the difference ; or that which is left after the taking a lesser number, or quantity, from a greater.

REMAL, in *Geography*, a town of Hindoostan ; 18 miles N.W. of Agimere.

REMLAND, a town of France, in the department of the Orne, and chief place of a canton, in the district of Mortagne. The place contains 1702, and the canton 11,683 inhabitants, on a territory of 202½ kilometres, in 12 communes.

REMANCIPATE, *To*, in *Commerce*, is to sell or return a commodity to him who first sold it.

REMANCIPATION, REMANCIPATIO, among the Romans, a form of divorce observed in marriages that had been contracted by *coemptio*. This was done by delivering the wife into the husband's hands ; so the marriage was dissolved

selfed by the husband's re-delivering the wife into any person's hands agreed upon between them.

REMAND, Fr., *To*, in *Military Language*, to send back; as when a soldier, who has been brought out of prison, or the guard-house, for the purpose of being examined or tried, is sent back, without any thing final occurring relative to his case.

REMANSO, in *Geography*, a town of South America, in the province of Cordova; 170 miles N. of Cordova.

RE-MARRYING, the repeating of a marriage; or the going through the solemnities of a second marriage.

Clandestine and uncanonical marriages are deemed null; and the parties are to be re-married in form; at least, it had always better be so to avoid disputes.

It was anciently expressly forbid to re-marry in the first year of viduity. M. Bayle observes, that a person who does not re-marry, is answerable to the public for all the time lost in his viduity, or widowhood.

REMBANG, in *Geography*, a town on the N. coast of the island of Java, where the Dutch had a resident merchant. It yields salt and timber, and was the place where the small vessels of the company were built; 45 miles N.E. of Samarang.

REMBERTUS, in *Biography*, the disciple, friend, and fellow labourer of Ansgarius, styled the apostle of the north, was a native of Thurholt, in Flanders, in the monastery of which, as well as in that of Corbey in Westphalia, he officiated as school-master. He was one of the first promoters of Christianity in Denmark, and in or about the year 860 he became bishop of Ribe. After the death of Ansgarius, in 865, he was appointed to the archbishopric of Hamburg, which office he held till his death, in 888. He wrote, in conjunction with a friend, the life of Ansgarius, which is inserted in the first volume of Langebeck's "*Scriptores Rerum Danicarum*." In this work Rembertus relates various facts, not elsewhere to be found, with regard to the state of Denmark at that period, but intermixed with fables. He collected extracts from Gregorius Magnus, whose works no longer exist, and he wrote many letters, one of which only is to be found in the second volume of Langebeck's collection. An account of Rembert's life and miracles is given in the same work. A Danish writer, quoted in the General Biography, to which we are indebted for this article, in speaking of Rembert's labours, says; "here we have not so much the commencement of Danish literature, as the seeds of it. They were sown by the exertions of Ebbo, Willehad, Ansgarius, and Rembert, but remained a long time, as it were, trodden down by the severe persecutions to which the Christians were exposed from Gormo the old, and other kings; and retarded in their growth by the rudeness and barbarism which formed the principal features in the character of a people, who were fonder of roving about on the seas to rob and murder, and of feasting and drinking, than of reading and writing books. At length, however, the seeds which he had scattered took root, sprung up in the 11th century, and in the 12th and 13th produced abundance of fruit." Gen. Biog.

REMBERVILLERS, in *Geography*. See RAMBERVILLERS.

REMBRANDT, VAN RYN, in *Biography*, was born at a village near Leyden, in 1605. The real name of his family was Gerretsz; but he acquired that of Van Ryn, from having resided in early life at a village upon the banks of the Rhine.

The little which this extraordinary artist owed to tuition was derived first from Zwanenburg, then from Peter Lastman, and afterwards from Jacob Pinas, from whose manner

some are induced to think that Rembrandt drew his own inclination for powerful oppositions of light and shade; but whatever hints he may have obtained from others at the outset of his practice, they were soon lost in the effulgence of his brilliant career, and absorbed in the lustre of his own over-powering abilities.

He was first brought into notice by having taken a picture to the Hague, and offered it for sale to an able connoisseur; who, conscious of his merit, treated him with kindness, and gave him a hundred florins for it. By this incident both himself and the public were made acquainted with his worth; and hence arose the reputation and success he afterwards enjoyed. Incessant occupation soon crowded upon him, and many pupils applied for admission into his school, with each of whom he received 100 florins a-year; and whose copies of his pictures he not unfrequently sold as originals, after bestowing a short time upon them himself. By these means, aided by incessant industry, and the sale of etchings, which he produced with great facility and skill, he accumulated considerable wealth: his income, according to Sandrart, being, for a length of time, at least 2500 florins yearly.

His place of residence, during this successful display of his talents, was Amsterdam, where his peculiarities procured him the character of a humorist, whilst his abilities astonished and delighted his contemporaries, and he produced those works which still gratify succeeding ages.

The peculiarities of his mind are as much observable in the manner of producing his effects, as in the choice of the materials. The execution of his earlier works was in a style highly laboured, with great neatness, and patient completion of the figures; such is that of the picture of the woman taken in adultery at Mr. Angerlein's. As he advanced in art, he took liberties with the pencil, wrought with all the broad fulness of the brush, and left the touch undisturbed: he even employed the stick, the pallet-knife, or his fingers, accordingly as they were most capable of producing the effect he desired, when seen at a proper distance, disregarding the appearance of the work upon a closer inspection.

In his pictures is exhibited a total inattention to the taste of the antique; he is even said to have made it a subject of ridicule, and to have jocosely denominated a collection of old armour and rich dresses, which he had collected and employed to study and paint from, "his antiques." These he evidently used as his models, though frequently in most heterogeneous combination; but by an innate power of seizing the most striking effects produced by light and shade, super-added to the most perfect mastery over the materials of the pallet, he always excited an interest, either by originality or beauty.

It is not, however, the approval of his power in the technical part of the art, which can or ought to satisfy the observer of the works of Rembrandt. Entering with the warmth of a poet into the nature of his subjects, he produced pictures which terrify with their sublimity, delight with their suavity, or gratify us with the most perfect transcripts of Nature, in her most varied aspects. Being himself possessed of the full force of his subject, he impresses it strongly, and notwithstanding the frequent vulgarity, and even deformity of the agents he exhibits, he extorts from us praise before we have time to consider the means by which we are stimulated to bestow it. To him every time and season was alike easy of representation; and all degrees of illumination, in form or quantity, he managed with the greatest perfection; no matter whether the scene arose from the breadth of the noon-day blaze, the dimness of twilight,

the darkness of night, or the glimmerings of the lonely taper; whether the light were spread over an extended space and a multitude of figures, or confined to the interior of a room, and serving only to illumine the books or the figure of a sequestered philosopher.

He was certainly a genius of the first class, although the objects upon which he exercised his powers bore little or no proportional value when compared with those selected by the best Greek and Italian masters. His invention was abundantly fertile, but employed generally among low characters and materials, although the subject he treated might be, as it frequently was, of a sacred or sublime quality. In designing the nude, he never appears to have had a thought of an elevated nature concerning form. Such as the model presented, he imitated with exactness, when he wished to be most perfect; but he sometimes seems to have sported with the idea of selection, by making figures demanding grace and beauty, such as Venus, Cupid, &c. still more vulgar, and in actions more disgusting, than those he drew of common life. The redemption of this vulgarity and meanness rests with the extreme force, depth, richness, brilliancy, and truth of his colouring, and the perfection with which he treated his chiaro-scuro; which conjointly fascinate the eye, and hold it in admiration, in spite of the deformities presented in design.

The power of Rembrandt in the art he practised was perfectly original, and its exercise quite unlike that of any other painter; being drawn from nature with the most faithful and discriminating eye, but with the most peculiar selection. Always powerfully and beautifully executed, but not unfrequently too artificial; and only agreeable because it is perfectly effective. All imitations of his style which are not well wrought, reduce it to manner, and only exhibit the artifice by which it is conducted.

To guess from the number and finish of his works, he must have painted with amazing facility. His system appears to have been that of using the ground as a half tint, and repeating the lights and darks till he had obtained the effect he sought for. His pencil, particularly in his earlier and more finished works, is remarkably delicate, yet full; and has never been exactly imitated; though some of his scholars, as Bohl and Eckhout, approached very near it: none of them, however, appear to have imbibed any large portion of his clear perception of natural effects, which so powerfully appeals to our sympathy in his scenes of twilight, of tempest, and the spirit-stirring gloom of night.

His pictures are justly and highly valued, and are rarely to be purchased; and then only at very high prices. We are possessed of many fine specimens of his talents, both in history and portraiture; and the gallery of the Louvre is rich in his smaller productions. At Florence also, and at Genoa, his name is esteemed, and his works preserved with due respect.

He lived to the age of sixty-eight, and died in 1674.

REMDA, in *Geography*, a town of Saxony, in the principality of Eifenach; 11 miles S.S.W. of Jena. N. lat. 50° 45'. E. long. 11° 19'.

REMEDIAL Part of a Law. See LAW.

REMEDIAL Statutes, are those which are made to supply such defects, and abridge such superfluities, in the common law, as arise either from the general imperfection of all human laws, from change of time and circumstances, from the mistakes and unadvised determinations of unlearned judges, or from any other causes whatsoever. And this being done, either by enlarging the common law where it was too narrow and circumscribed, or by restraining it where it was too lax and luxuriant, hath occasioned another subordinate division

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of remedial acts of parliament into enlarging and restraining statutes. *E. gr.* In the case of treason, clipping the current coin of the kingdom was an offence not sufficiently guarded against by the common law; therefore it was thought expedient by statute 5 Eliz. cap. 11. to make it high treason, which it was not at the common law; so that this was an enlarging statute. At common law also spiritual corporations might lease out their estates for any term of years, till prevented by the statute 13 Eliz. cap. 10. This was, therefore, a restraining statute. Blackst. Com. book i.

REMEDIOS, in *Geography*, a town of South America, in the province of Popayan; 71 miles S. of Santa Fé de Antioquia.

REMEDIOS, or *Nuestra Señora de los Remedios de Pueblo Nuevo*, a town of Mexico, in the province of Veragua; 90 miles W.N.W. of St. Yago. N. lat. 8° 44'. W. long. 82° 16'.

REMEDIOS, or *Payasal*, a town of Mexico, in the province of Yucatan, in lake Pue. N. lat. 17° 3'. W. long. 91° 46'.

REMEDIOS, a town of New Navarre; 120 miles S. of Casa Grande.

REMEDY, in *Law*, is the action or means given by law for the recovery of a right.

REMEDY, *Remedium*, in *Medicine*, any physical agent by which a disease may be alleviated or cured.

Remedies are either *general* or *topical*; the former comprehending such as influence the actions of the whole frame, as blood-letting from any large vein, the cold-bath, and almost all those medicaments or drugs which are taken into the stomach; the latter including those which are applied to, or in the vicinity of, any particular part which is diseased: thus, among *topical* remedies, are blood-letting by leeches or cupping, blisters, issues, cataplasms, ointments, plasters, &c.

The operation of remedies is rather a question of experience than of logical investigation. Some remedies, the number of which appears to be very limited, possess a *specific* power of curing certain diseases. There are, perhaps, not more than two medicines, however, that are fairly entitled to the appellation of *specifics*: these are mercury, which cures the venereal disease, and sulphur, which cures the itch. The bark of cinchona has, indeed, been deemed a specific for intermittent fevers; but it is not entitled to such a character: and the eau medicinale, which has recently been brought forward as a specific for the gout, appears to have lost much of its reputation. The pretended specifics daily advertised for many diseases by quacks, are mere impositions, being commonly disguised forms of the most active and dangerous medicines which are employed cautiously by the faculty; such as arsenic, corrosive sublimate, and other preparations of mercury; laudanum, hemlock, and other narcotics. Of the former species are Ward's ague-drop, and his white drop; of the latter, are Dalby's carminative, Godbold's balsam, and many others. The danger resulting from the use of these nostrums, arises from the indiscriminate administration of them in many diseases which have a similar name, but which vary much in different constitutions, and at different periods of life. Much injury is done by the constant sale of these pretended specifics, by the impression which it contributes to maintain, that each disease has its specific remedy; whereas no opinion can be farther from the truth. When it is considered that almost every disease, though similar in name, arises from several causes (which we have already illustrated when speaking of Cough), it will be obvious that the same remedies must be applied, upon general principles, to diseases of different name, and different remedies to those which have the

same appellation; and that, therefore, the cure of diseases is not to be effected by applying a certain remedy to a certain disease nominally the same, but only by first ascertaining the laws of the living body, and of its various organs, both in a state of health and of disease: in other words, the proper application of remedies can only be learned by much observation of diseases, after a previous study of the anatomy and physiology of the animal frame.

REMEDIES *Appended.* See APPENDIX.

REMEDY *for the Master of the Mint, in Coinage,* denotes a certain allowance for deviation from the standard weight and fineness of coins. In some places the remedy is allowed in the weight, in others in the fineness; but mostly in both weight and fineness. It is considered generally as an allowance for the fallibility of workmanship; but in some foreign mints it is made a source of emolument: and when governments issue coins at a rate above their intrinsic value, the profit thus made is called "seignorage." Out of every fifteen pounds of gold coined at the mint in London (according to the account published by the learned Mr. Folkes, in his curious tables of English silver coins), some pieces are taken at random, and deposited in a strong box, called the *pix*: at certain intervals, sometimes of one year and sometimes of several years, the *pix* is opened at Westminster, in the presence of the lord chancellor, the lords commissioners of the treasury, and others; portions taken from the pieces of each coinage are melted together, and an assay made of the collective mass by a jury of the goldsmiths' company. At this trial the mint-master is held excusable, though the monies be either too base, or too light; provided the imperfection and deficiency together are less than the sixth part of a carat, which amounts to forty grains of fine gold on the pound of standard, or the one hundred and thirty-second part of the value. It is said that this remedy is contained within as narrow limits, as any workers can reasonably be supposed to make themselves answerable for. The remedy for silver coins is two pennyweights in the pound. If the deficiency or excess of the coin should be more than this, either in the weight, or in the fineness, or in both together, the money must be recoined at the expence of the master of the mint; and no allowance is made for remedy unless the error is supposed to have casually happened.

REMEE, in *Geography*, a town of Bengal; 16 miles S. of Koonda.

REMEMBRANCE, is when the idea of something formerly known recurs again to the mind, without the operation of a like object on the external sensory. See MEMORY, REMINISCENCE, and RECOLLECTION.

REMEMBRANCERS *of the Exchequer*, are two officers, or clerks, therein, formerly called *clerks of the remembrance*.

They are now distinguished by the appellations of the *king's remembrancer*, and the *lord treasurer's remembrancer*. There is also another officer, called the *remembrancer of first-fruits*. Their business is to put the lord treasurer and justices of the court in remembrance of such things as are to be called upon, and dealt in for the king's benefit.

REMEMBRANCER, *The King's*, enters into his office all recognizances taken there before the barons, for any of the king's debts; for appearance; or for observing orders; and makes out process against the collectors of customs, subsidies, excise, and other public payments, for their accounts. All informations upon penal statutes are entered in this office; and there all matters upon English bills in the exchequer-chamber remain. He makes the bills of composition upon penal laws; takes the statement of debts; has

delivered into his office all manner of indentures, fines, and other evidences whatsoever that concern the assuring of any lands to the crown: he every year, in *crastino Annarum*, reads, in open court, the statute for election of sheriffs, and gives them their oath, and reads the oath of all the officers of the exchequer, where they are admitted.

REMEMBRANCER, *The Lord Treasurer's*, is charged to make process against all sheriffs, escheators, receivers, and bailiffs, for their account; process of fieri facias, extent for any debts due to the king, either in the pipe, or with the auditors; and process for all such revenues as are due to the king, by reason of his tenures. He also makes record, by which it appears, whether sheriffs, or other accountants, pay their proffers due at Easter and Michaelmas. He makes another record, whether sheriffs, or other accountants, keep their days of prefixion: all estreats or fines, issues, and amerciaments, set in any of the courts of Westminster, or at the assizes or sessions, are certified into his office, and are by him delivered to the clerk of the estreats to write process upon them, &c.

REMEMBRANCER *of the First Fruits*, he who takes all compositions and bonds for first fruits and tenths; and makes process against such as do not pay the same.

REMEMBRANCER is also the title of an officer in the city of London, who is to attend the lord mayor on certain days, and whose business is to remind his lordship of the select days, when he is to go abroad with the aldermen, &c. He is to attend daily at the parliament-house during the sessions, and to report to the lord mayor their transactions.

REMI, ST., in *Biography*, archbishop of Rheims, who converted Clovis to Christianity, and baptized that monarch. He died about the year 535. There are some letters which pass under his name, but they are of a very doubtful authority. There was another saint of this name, or, as he is sometimes styled, REMIGIUS, who was archbishop of Lyons, and presided in the council of Valentia in 855. He was a steady supporter of the doctrine of St. Augustine, on grace and predestination, in several works that are now extant. He died in 875.

REMI, JOSEPH HONORE, an advocate in the parliament of Paris, was born in 1738. At the age of eight he lost his sight, and it was believed irrecoverably, by the small-pox; but when he had attained the age of fourteen he was in the enjoyment of his eyes. He was author of a burlesque poem, entitled "*Days*," in opposition to Young's *Night Thoughts*; but his principal work is an eloge on the chancellor de L'Hôpital, which was crowned by the French academy in 1777, and censured by the Sorbonne. He also wrote the eloges of Moliere, Colbert, and Fenelon, and furnished the articles relating to jurisprudence for the French Encyclopædia. He died in the year 1782.

REMI *of Auxerre.* See REMIGIUS.

REMI, *Order of St.*, or of the *Holy Vial*, an order of knighthood in France, which, according to the most approved historians of that kingdom, was instituted by Clovis, king of France, in the year 499. The reigning king of France is always sovereign of this order, and the knights companions are never more than four; nor is it ever conferred on any persons but the barons, Terrier, Belestre, Venestre, and Louverse, who stile themselves baron knights of the Holy Vial, and are the bearers of the canopy under which the vial is carried from the abbey of St. Remi to the cathedral of Rheims, for the inauguration of the kings of France at their coronations. The badge of this order, which is worn pendant to a black ribbon, is "a cross of gold, enamelled white, cantoned with four fleur-de-lis; on the cross,

cross, a dove descending, dipping its beak into a vial held in a hand, all proper."

REMICH, in *Geography*, a town of France, in the department of the Forêts, and chief place of a canton, in the district of Luxembourg, seated on the Moselle; 12 miles E. of Luxembourg. The place contains 1480, and the canton 10,885 inhabitants, on a territory of 230 kilometres, in 15 communes.

REMIGES, in *Ornithology*, denote the primary and secondary wing-feathers.

REMIGIO, **FIORENTINO**, in *Biography*, a man of letters in Italy, was a native of Florence. He entered at an early period into the Dominican order, and was called to Rome by pope Pius V. to superintend an edition of the works of St. Thomas. He was himself a considerable author, and published "A Commentary on the whole Scriptures;" translations of "Ammianus Marcellinus;" "Cornelius Nepos;" and "Fazello's History of Sicily;" "Reflections on Guicciardini's History;" "Italian Poems;" and "A Translation in Verse of Ovid's Heroic Epistles," of which an elegant edition was printed at Paris in 1762. He died at Florence in 1580, about the age of 62. Moreri.

REMIGIUS. See **REMI**.

REMIGIUS of Auxerre, a learned French Benedictine monk in the ninth century, derived his surname from the abbey of St. Germain, at Auxerre, where he embraced the religious profession. He distinguished himself by his proficiency in profane and sacred literature, at a dark and barbarous period, and was placed at the head of the schools belonging to his monastery. About the year 882, he was called to Rheims by Foulques, the successor of Hincmar in that see, who gave him the direction of the literary seminary which he had founded in his metropolitan city. Here he taught with great reputation for several years, after which he went to Paris, where he opened the first public school in that city, after the decline of learning which followed the ravages of the Normans. In the life of pope Formosus, by Platina, the name of Remigius of Auxerre is the only one that occurs of a person eminent for learning under that pontificate. He was author of "Commentarius in omnes Davidis Psalmos," which was published at Cologne in 1536. It consists very much of the collected opinions and explanations of St. Ambrose, St. Augustine, and Cassiodorus, reduced into one mass.—Another work of this author was entitled "Enarratio in posteriores XI. minores Prophetas," published at Antwerp in the year 1545, with the "Commentaries" of Oecumenius upon the Acts of the Apostles, and their Epistles, and those of Arethas upon the book of Revelation; and "Expositio Misæ," deduced from the sentiments and authority of the fathers. Some critics have given, among the productions of Remigius, the "Commentary upon the Epistles of St. Paul," which by others has been ascribed to St. Remi, or Remigius, but which in truth are supposed to belong to Haymo, a German bishop, who flourished in the ninth century, and who was author of a long list of theological works. Such at least is the opinion of Du Pin, in opposition, indeed, to the authority of Mosheim. Moreri.

Remigius left behind him "A Commentary on the Musical Treatise of Martianus Capella," which is still subsisting among the MSS. in the king of France's library, N° 5304. He acquired his science from Heric. Heric was the disciple of Rabanus, and Hayman of Halberstadt, who had conversed with the Roman singers sent into France by pope Adrian.

REMILLY, in *Geography*, a town of France, in the department of the Ardenes; 7 miles W. of Charleville.

REMINISCENCE, **REMINISCENTIA**, is that power of the human mind, by which it recollects itself, or calls again to its remembrance such ideas or notions as it had really forgot: in which it differs from *memory*, which is a treasuring up of things in the mind, and keeping them there, without forgetting them.

Hence memory may be considered as a continual remembrance; and reminiscence as an interrupted memory.

How near akin forever the two faculties may seem, yet they are generally found separated; so that they who excel in the one, are generally defective in the other.

The ancient Platonists were of opinion, that all learning and knowledge consisted in the reminiscence or recollection of notions which had been in the soul before its union with the body.

REMINISCERE, the second Sunday in Lent; anciently thus called from the first word of the introit of the mass said for that day, "Reminiscere miserationum tuarum."

REMIREA, in *Botany*, Aubl. Guian. 44. t. 16. Brown Prodr. Nov. Holl. v. 1. 236. (See **MIEGIA**.) We are unacquainted with Mr. Brown's reasons for preferring the above name, whose origin does not appear, and which the classical Schreber rejected as barbarous.

REMIREMONT, in *Geography*, a town of France, and principal place of a district, in the department of the Vosges; 10 miles S.E. of Epinal. The town contains 3250, and the canton 14,916 inhabitants, on a territory of 235 kilometres, in 15 communes. N. lat. 48° 1'. E. long. 6° 40'.

REMISIT. — *Recto quando dominus Remisit*. See **RECTO**.

REMISSAM, in *Geography*. See **REMSA**.

REMISSION, in *Law*, &c. denotes the pardon of a crime, or the giving up the punishment due to it.

REMISSION, in *Medicine*, is when a distemper abates, but does not go quite off, before it returns again: as is common in fevers which do not quite intermit. See **REMITTENT**.

REMISSION, *Remissio*, in *Physics*, the abatement of the power or efficacy of any quality. In opposition to the increase of the same, which is called its *intension*.

In all qualities capable of intension and remission, the intension decreases as the squares of the distance from the centre of the radiating quality increase.

REMISSION, *Remissio*, *aversus*, in the *Ancient Music*, was used to signify the passage of the voice from acute to grave, being opposite to intension.

REMIT, in *Commerce*. To remit a sum of money, bill, or the like, is to send a sum of money, &c.

To remit is also used among bankers for what is accustomed to be given a banker, or, as it were, discounted with him, for his giving a bill of exchange.

To remit is also to give up part of one's due to a debtor; as, I would remit you a fourth of what you owe on condition of paying me the rest in hand.

REMITTANCE, in *Commerce*, the traffic or return of money from one place to another, by bills of exchange, orders, or the like.

A remittance is properly a bill of exchange, or the like, sent to a correspondent, and the content of it to be received by him, or some other person, on whom it is drawn. By means of these remittances, large sums of money are returned from one city to another, without danger, without carriage, &c.

In London it is easy to get remittances upon any city in the world; in the country it is more difficult.

REMITTANCES, *Book of*. See BOOK.

REMITTANCE is also used in speaking of the payment of a bill of exchange.

REMITTANCE also denotes the due or fee allowed the banker or merchant, both on account of his trouble, and the different value of the species in the place where you pay the money, and where he remits it.

This remittance is more usually called *change* and *rechange*.

REMITTENT, in *Medicine*, implying also the word *fever*, is a fever which is characterised by a regular decrease and exacerbation of its symptoms every day, and differs from an *intermittent*, inasmuch as the symptoms never disappear altogether, and the exacerbation is neither begun by the complete rigors, nor terminated by the profuse sweat, which occur in the latter. The remittent fever, however, originates, in common with the intermittent, from the influence of marsh effluvia, but under particular circumstances, which will be stated immediately.

It is scarcely necessary to describe minutely the symptoms of the remittent fever after the ample detail which we have given of those of fever in general (see FEVER); and it varies extremely in its character, according to the season, climate, and other circumstances under which it appears. In its milder forms, the remittent begins with chilliness, lassitude, pains in the bones, head-ache, and a disordered condition of the stomach, loss of appetite, sickness, and even vomiting. At night the febrile symptoms run high; the heat and thirst are great, the tongue and mouth are parched, the pain of the head is violent, the patient is totally unable to sleep, and is continually tossing and tumbling about, and often becomes delirious. But generally in the morning, an imperfect sweat brings on a remission of all the symptoms. In the evening, the paroxysm returns, but is not preceded by any cold fit or shivering; yet it is commonly more severe than the former. Next morning it remits as before; and these periodical changes recur daily, becoming, however, less marked, if the disease be neglected, until the fever insensibly assumes a continued form. The pulse is full and quick during the exacerbations, and continues during the remissions to indicate fever; but rigors seldom precede the fits after the first attack. Many patients discharge a bilious matter from their stomachs by vomiting, and all are disordered in that organ. In the more violent forms, which take place in hotter seasons and climates, the disease often seizes the patient at once with a burning and violent head-ache, with little or no sensible chilliness preceding it. The thirst and heat are intense, and acute pains in the back and all the limbs, with extreme lassitude and inquietude, harass the patient, and nausea, vomiting, and pain of the stomach ensue. In some instances, indeed, the head becomes so suddenly and violently affected, that a violent delirium, assuming the appearance of insanity, seizes the patient without any previous indication, until the remission evinces the nature of the disease. Many of the sick become yellow, as if affected with jaundice. Indeed, the remittent fever assumes every degree of violence, from the autumnal bilious fever of temperate climates, to the most severe *yellow fever* of tropical countries.

The circumstances under which these varieties of form occur, have been amply ascertained by experience. The combination of marsh effluvia and great heat are necessary to the production of these fevers; and they are violent, nearly in proportion to the degree of the latter. In cold climates, and in cool seasons, as the spring, the miasmata excite but the common intermittent ague. But in the au-

turnal season, especially when the heat is considerable, and the quantity of miasma great, as in the Low Countries, in particular years, the production of these fevers is very extensive; they become actually endemic, and affect especially those persons who are not accustomed to the climate. The experience of all our military expeditions to Holland and Flanders, in the autumnal season, affords fatal proof of this truth. (See the writings of sir John Pringle, Dr. Home, &c. on the Diseases of the Army in the Campaigns of 1742—1748, inclusive. And the severe epidemic of Walcheren, at a more recent period, cannot be forgotten.) In these climates, the *remittent* usually commences at the close of summer, in a milder form, and gradually assumes a more violent and formidable character, as the heats of autumn advance. But if we extend our inquiries to the hotter regions of the globe, we find the disease under its most severe and fatal forms. In the south of Europe, especially in Spain, and those parts of the Mediterranean coasts where miasmata are found, the autumnal remittent becomes a formidable malady in particular seasons; but we must proceed to the West Indies and America to discover the disease in its most terrific form; for although there may be a contagious fever, which puts on the *yellow* or bilious character, Dr. Bancroft appears to have demonstrated, satisfactorily, that the *yellow fever*, commonly so called, is but the severest form of the endemic remittent of the hot seasons of hot climates. (See his able "Essay on the Disease called Yellow Fever, &c." 1811). He affirms, indeed, that all fevers, occurring in those countries in which the atmospheric heat rises, during certain seasons, to the 85th degree of Fahrenheit's thermometer, have a tendency to assume that violent and dangerous appearance, which is usually considered as characteristic of the yellow fever.

The testimony of all experienced medical observers concurs in proving the origin of remittent fevers from the influence of miasmata. Thus, among the historians of disease, as it occurs among seamen in warm climates, Drs. Lind, Blane, Hunter, and others, have demonstrated the exclusive attacks of these fevers to be among those men who have gone on shore, in swampy grounds, for water, &c.; and especially among those who spend the night on shore. Many instances are recorded, in which all the men so employed have been seized with fevers, while the rest of the ship's company have remained in health. (See Dr. Lind, on the Diseases incidental to Europeans in Hot Climates, p. 27. 221, &c. 5th edit. Dr. Blane, on the Diseases of Seamen, p. 92, and 392.) Again, sir John Pringle, in his valuable work on the diseases of the army, has not only stated many facts which occurred under his own observation, but has adduced many proofs from the writings of ancient physicians and historians, in corroboration of the evidence that these fevers have, every where, and at all times, originated in hot seasons, in circumstances where miasmata existed. (Part 3. chap. iv. sect. 3.) In times, indeed, not very remote, when the want of proper means of carrying off the filth and refuse of large towns by proper drains, and scavengers were not employed, and when the materials for the production of miasmata were accumulated even in the streets, the remittent and intermittent fevers were epidemic, in favourable seasons, for the generation of the miasmata, and the source of considerable fatality. Thus, even in London, Dr. Short remarks that, early in the seventeenth century, "one of forty of the whole that died of fevers, died of agues." (See his New Observations, &c. on Bills of Mortality, p. 203.) And Burnet, in his History of the Reformation, says, that in the last year of queen Mary's reign, they "raged like a plague." At a later period, we have

have the testimony of Sydenham and Morton, in proof of the great prevalence of remittents in London; and Morton affirms that they were extremely destructive for several years before the great plague, *viz.* from 1658 to 1664. He states that Oliver Cromwell died of an attack of remittent fever in the former of these years, and that he lost his own father, who was himself an experienced physician, from the same disease, which had gone through his whole family. (Morton, *Pyretologia*, append. ad Exerc. ii.) "The result of the whole, therefore, is," to use the words of sir John Pringle, "wherever the greatest causes of moisture and putrefaction in the air exist, there also will be seen the greatest number and the worst kinds of the remitting and intermitting fevers." This truth is farther confirmed by the negative evidence, that these fevers have ceased to exist where marshes have been drained, where towns have become cleanly, when armies have moved to dry situations, and when the heats of particular seasons have ceased, or failed to occur.

What the nature of these miasmata is, the investigations of philosophers have not yet taught us. Dr. Bancroft has entered at great length, and with great ability, into this question, reasoning from a large collection of important evidence. He details a number of interesting facts, which seem to lead satisfactorily to the conclusion, that the mere exhalations from *putrefying animal matter*, however offensive to the senses, are never productive of fevers. The same inference has been deduced, not less satisfactorily, by Dr. Chisholm, in a very elaborate and able dissertation upon this topic, published in the *Edinburgh Medical and Surgical Journal* for October, 1810, vol. vi. p. 389. However contrary to the general opinion, this doctrine, that mere putrefaction is not the source of contagion and fever, appears, indeed, by these writers to be established. The experiment, in fact, has been tried on a large scale in France, in the case of the prodigious exhumations made in the church-yard of St. Eloi, at Dunkirk, in 1783, and in that of the saints Innocents at Paris, in 1786. In the latter case, nearly 20,000 bodies were taken up, in every stage of putrefaction, and a considerable part of the work was carried on during the greatest heats of summer, rendering the whole city offensive; yet no fever was occasioned by this immense mass of corruption. (See M. Thouret's *Memoir* in the *Journal de Physique*, for 1791, p. 253; and the *Annales de Chimie*, vol. vi.) The good health of nightmen, of persons living in dissecting-rooms, of those employed in the manufactory near Bath of a sort of spermaceti from putrefying flesh of all descriptions, and many other striking facts, detailed by the two authors just quoted, constitute a strong evidence in proof of the absence of insalubrity from mere putrefaction.

Dr. Bancroft next proceeds to prove, by another ample collection of facts and testimonies, that it is not the mere *aqueous vapour* that constitutes the morbid quality of miasmata. The principal proofs that mere moisture is incapable of producing these fevers, are, that sailors at sea for many months are generally very healthy; that no set of men are more uniformly so than the Newfoundland fishermen, who are usually enveloped in the dampest fogs for several months together; that while persons living on shore on unwholesome islands, as at Walcheren, are speedily attacked with fevers, those who remain on ship-board, at a little distance from land, entirely escape them; and that the occurrence of these fevers has been frequently prevented by laying swampy ground under water, under which circumstances the moisture of the atmosphere must be highly augmented.

Considering, then, that the mineral part of the soil is not vaporizable in any natural heat, and that animal substances

in a state of putrefaction are incapable of producing fever, as well as the mere aqueous vapour, Dr. Bancroft was disposed to conclude, that the morbid exhalations in question arise wholly from "the mutual decomposition of vegetable matters and water;" and that those swampy grounds are most likely to emit them, which contain the largest proportion of such matters, and in which the decomposition is most rapid and complete. This conclusion, he is of opinion, is confirmed by the facts that the exhalations from macerating hemp and flax are well known in Italy to produce fevers, and that those arising from heaps of decaying indigo, in the East and West Indies, have produced the same effects. See his *Essay on Yellow Fever*, above quoted.

Of the Treatment of Remittent Fevers.—As the violence of the symptoms, and consequently the actual character of these diseases, vary materially in different seasons, climates, and circumstances, under which they occur; so no uniform rule of treatment can be pursued for their cure. The same remedies, indeed, which at one period of the same fever are beneficial, are hurtful if resorted to at another. This observation, however, is applicable to all febrile diseases, and cannot be too often inculcated; since not only empiricism, but the routine of too many of the profession, tends to the appropriation of some leading remedy, whenever the name of a particular fever is mentioned: with some it is bark, with others antimony, and with others mercury; the indiscriminate use of any of which must be necessarily productive of injury.

In the more violent forms of the disease, which are common in hot climates, and in which the attack is marked by a sudden and severe affection of the head, with a hard, full, and strong pulse, indicating, with other symptoms, an inflammatory affection of the brain, perhaps the only remedy which is capable of arresting the disease, is speedy and free *blood-letting*. In the most violent forms of all, this evacuation should be resorted to very early, as within the first twenty-four hours, or the mischief will have advanced beyond the reach of this remedy. In milder cases, a moderate bleeding from the temporal artery or jugular vein, or even from the arm, within the first day or two, will often remove the danger and severity of the fever. The repetition and extent of the bleedings must be determined by a consideration of the violence of the symptoms, the duration of the disease, and the vigour of the patient. The notion that these fevers of hot climates are of a *putrid* nature, because they speedily run on to symptoms of debility, or putrescency, as they have been called, appear to be altogether erroneous; and it is now generally admitted, that the only effectual mode of preventing these symptoms, is by arresting the violent inflammatory excitement in the beginning, of which they are the immediate effect.

The next most effectual remedy, if resorted to also sufficiently early, is purgation. The purgatives administered should be such as in bulk and quality are not calculated to offend the stomach, which is usually in an irritable state: calomel, with jalap, answers the purpose well; and it is in all probability by its purgative quality alone, that mercury has been found beneficial in these fevers. The efficacy of mercurial purgatives, indeed, seems to have been fully established by the recent experience of our naval and military practitioners, in every quarter of the globe; while the mercurial practice, which had for its object the excitement of salivation, is shewn by Dr. Bancroft, from the testimony of Dr. Rush and others, its advocates, to have been by no means successful.

This early excitement is also considerably alleviated by the application of *cold* in every mode. Almost all the modern

dern writers bear their testimony to the important auxiliary operation of the cold and tepid affusion; although they admit that, alone, its effects are not sufficiently powerful or permanent to be depended upon. *Coolness* of the patient is to be promoted by every means; by the free use of cold aqueous drinks, by frequent washing, by the full admission of fresh air, and by the use of few and light coverings on the bed.

These remedies should be actively employed, and repeated on the return or non-cessation of the symptoms of excitement. For as an intelligent physician has remarked, "the great object is the removal of the local affection of the brain, or other organ, and the production of a complete remission of the febrile symptoms, in the least possible time, by which the dangerous symptoms of the latter stages are prevented or greatly mitigated, and a perfect and rapid recovery insured." (See Dr. Burnett's Account of the Bilious Remittent Fever in the Mediterranean, p. 22. Lond. 1814.) This object is rather impeded, than assisted, by the administration of emetics and sudorifics; and altogether defeated by the use of bark, cordials, or stimulants of any kind, whether in the way of food or medicine. With respect to emetics, they are objectionable in all stages of the disease; for they not only fail in removing nausea, but actually increase that distressing symptom: their operation aggravates the affection of the head, of which the nausea appears to be sympathetic; and as the tendency of the disease is to augment irritability of the stomach, which often becomes extreme and distressing in the latter stages, so they contribute to aggravate this and other dangerous symptoms. Sudorifics are also to be condemned; for, in the first place, they are unnecessary, because a natural perspiration will readily ensue, as soon as the excess of heat above the standard of health has been removed, which can be accomplished with certainty by the proper application of cold water to the surface of the body; and, in the next place, the sudorifics which are used are apt to increase the irritability of the stomach; and if they fail to excite a diaphoresis, they increase the heat and the determination to the head, and tend to lengthen the paroxysm. With regard to the bark and cordials, they are invariably injurious in the first stage of the fever. When a distinct remission has taken place, some writers recommend the immediate administration of cinchona; but even these admit, that "if it be given when there is a parched skin, a hard pulse, a dry tongue, great heat and pain at the stomach, or delirium, it will generally be found to increase and prolong these symptoms." (See Bancroft, loc. cit. p. 76.) On the whole, however, the late experience in the Mediterranean led to the rejection of the use of bark, while any febrile symptoms whatever remained. "Under its use," says Dr. Burnett, "mortality has been great, relapse frequent, and (as in the cases of the *Temeraire* and *Invincible*) dysentery attacked nearly all the patients who had fever in a severe form; nor was there an instance, as far as I could learn, that, when given during a supposed remission of the symptoms, it prevented a return of the paroxysm. Too often it has been given with wine at the commencement of this disease, when the tongue has soon put on a brown, dry, and furred appearance; the anxiety, delirium, and irritability of the stomach, have been much increased; the whole train of nervous symptoms soon became formidable, resisting every means of alleviation, till death has put a period to the sufferings of the patient." Loc. cit. p. 34.

If any thing were wanting to corroborate the foregoing deductions from experience, in favour of the antiphlogistic and evacuant plan of treatment, in the commencement of

remittent fevers, the detail of the appearances observed on dissection, after the death of patients in these fevers, would amply support them, by the proofs which it affords of the inflammatory condition of various organs of the body in these fatal cases. In different instances, investigated by Dr. Burnett and his colleagues in the Mediterranean, the vessels of the brain were generally distended, and in many cases completely gorged, with blood; the membranes of that organ were considerably inflamed, often presenting what that writer calls "a blood-shot appearance," and depositions of coagulable lymph were seen among the convolutions: there were occasionally also adhesions, and the ventricles were often distended with a fluid, sometimes limpid, sometimes yellow. Appearances of *high inflammation* presented themselves in the cavity of the chest, affecting the lungs, pericardium, and diaphragm; and these were connected with depositions of lymph and effusions of serum. In the abdomen, the liver was generally found enlarged, and sometimes exhibiting marks of inflammation; the stomach distended with air, more or less inflamed, and containing a dark coloured matter; and the intestines in a similar condition, with frequent intussusception.

These appearances, which are in fact the effect of the continuance of the febrile actions in the organs in question, sufficiently prove that the first stage is the time when active remedies, of an anti-inflammatory power, can be chiefly expected to produce a very decided removal of the disease. When the fever is a little more advanced, the principal object of the practitioner is to diminish the violence of any local affection that may be severe. Thus, if head-ache remains, with flushed countenance, suffusion of the eyes, and a firm pulse, a small bleeding from the temporal artery (the pulse being at the same time carefully examined) may be employed with advantage: a blister, applied to the head at this time, is also manifestly beneficial; and daily evacuations of the bowels should be procured by gentle laxatives, such as castor oil, or glysters, the powerful cathartics being now laid aside. Irritability of the stomach, which is often distressing at this period, is relieved by the effervescing draught, and by the application of leeches, or of a large blister to the pit of the stomach. A degree of stupor sometimes supervenes, which is often removed by a blister applied to the neck or forehead, or by the application of leeches to the temples. If there is any obvious affection of the abdominal viscera, which should be carefully inquired into, blisters, and, above all, the warm bath, should be resorted to, as well as copious emollient glysters.

If, however, from want of the means of relief, or from the violence of the disease, it has advanced to that stage, in which the yellow suffusion of the skin appears, and various nervous symptoms, subsultus, tremors, &c. come on, with increased uneasiness about the stomach, hiccup, or vomiting of a dark matter, resembling coffee-grounds, with ischuria, and a sinking or intermission of the pulse, little more can be done than to look on, and endeavour to obviate symptoms as they occur. "Singultus," to borrow again the words of Dr. Burnett, "is a dangerous, and commonly a most harassing symptom at this time: it will often be relieved by camphorated julep, to which may be added opium and ether. If the pulse sink, the stimuli must be increased; and under these circumstances, I have found the carbonate of ammonia, with aromatic confection, of singular benefit. But while we endeavour to restore the circulation, *care must be taken not to induce a state of secondary excitement*; and as the pulse rises, the stimuli should be decreased. Constant attention must still be paid to the daily evacuation of the bowels; but at a period, when the excitability of the system

tem is nearly destroyed, powerful cathartics will be attended with the most deleterious consequences: glysters are particularly serviceable at this time. As the disease advances, the secretions are at times voided involuntarily: in a few I have observed a retention of urine, and in these last cases the catheter should be used; but as a general symptom, there is far oftener a deficiency in the secretion of that fluid. Frequently in this state, the stomach rejects every thing. We may now safely indulge the patient *moderately* with any thing to which his fancy leads him. Bottled porter, wine, and brandy and water, have been found beneficial. But no remedy can be relied on with any degree of certainty: whatever calms the irritability of the stomach, and moderately supports the excitability of the system, is useful. A few spoonfuls of arrow-root or sago, with wine and spice, given occasionally, will often be retained by the patient, and greatly at this period assist the cure." Burnett, loc. cit. p. 29.

During the *state of convalescence* at every period, whether from a complete remission being procured early, or from a gradual cessation of the disease, extreme caution is necessary in regard to preventing repletion: in the former case, it is apt to induce a relapse; and in the latter, it will retard the cure. During the whole progress of recovery, attention should be paid to the regularity of the bowels. Some light tonic, as an infusion of quassia, gentian, or cinchona, with an aromatic or sulphuric acid, may be administered. When the yellow suffusion of the skin has been great, a protracted convalescence is commonly the consequence; and is often attended with irregular affections of the bowels, and symptoms of indigestion. In these cases, small doses of the mercurial pill, with an occasional gentle purgative of castor oil or rhubarb, are very beneficial. It is almost exclusively, indeed, in these protracted cases, where a morbid affection of the liver, brain, or some other viscera, has been the result of the uninterrupted violence of the first stage of the fever, and especially when there is reason to suppose that assuasion had taken place within the cranium, that mercury, in small doses, is of any actual utility. Small doses of calomel, or of the pilula hydrargyri, should be administered until some sensible, but slight, effect be produced on the salivary system; after which the disease often ceases of itself, or is readily removed by the use of the Peruvian bark. See Burnett on the Bilious Remittent in the Mediterranean; Bancroft on the Yellow Fever; and Irvine on the Diseases of Sicily. See also FEVER, *Yellow*, and MIASMA.

REMITTENT *Fever of Children*, the *febris infantum remittens* of Dr. Butter, which is a very common affection of children, when the abdominal organs are deranged, has already been described at length, under the head of INFANTS, § 5. *Febrile Diseases of*; which see.

REMITTER, in *Law*. Where a man has two titles to land, and is seised by the latter; and, that proving defective, he is remitted or restored to the former more ancient title; this is called a *remitter*, from the Latin, *remittere*, to send back.

If land descend to him that had right to it before, he shall be remitted to his better title, if he please. 1 Inst. 347. b. Litt. § 659.

Remitter is classed (with *retainer*) by judge Blackstone, among those remedies for private wrongs, which are effected by the mere operation of law, and is thus described: remitter is where he, who hath the true property or *jus proprietatis* in lands, but is out of possession thereof, and hath no right to enter, without recovering possession in an action, hath afterwards the freehold cast upon him by some subsequent, and of course defective title: in this case, he is re-

mitted, or sent back, by operation of law, to his ancient and more certain title. (Litt. § 659.) The right of entry, which he hath gained by a bad title, shall be *ipso facto* annexed to his own inherent good one; and his defeasible estate shall be utterly defeated and annulled, by the instantaneous act of law, without his participation or consent. (Co. Litt. 358. Cro. Jac. 489.) As if A disseises B, that is, turns him out of possession, and dies leaving a son C; hereby the estate descends to C, the son of A, and B is barred from entering thereon till he proves his right in an action: now, if afterwards C, the heir of the disseisor, makes a lease for life to D, with remainder to B the disseesee for life, and D dies; hereby the remainder accrues to B, the disseesee; who thus gaining a new freehold by virtue of the remainder, which is a bad title, is by act of law remitted, or in of his former and surer estate. (Finch. L. 194. Litt. § 683.) For he hath hereby gained a new right of possession, to which the law immediately annexes his ancient right of property.

If the subsequent estate, or right of possession, be gained by a man's own act or consent, as by immediate purchase being of full age, he shall not be remitted. For the taking such subsequent estate was his own folly, and shall be looked upon as a waiver of his prior right. (Co. Litt. 348. 350.) Therefore it is to be observed, that to every remitter there are regularly these incidents; an ancient right, and a new defeasible estate of freehold, uniting in one and the same person; which defeasible estate must be *cast upon* the tenant, not gained by his own act or folly. The reason given by Littleton (§ 661.), why this remedy, which operates silently and by the mere act of law, was allowed, is somewhat similar to that given under the article RETAINER; because otherwise he who hath right would be deprived of all remedy. For as he himself is the person in possession of the freehold, there is no other person against whom he can bring an action, to establish his prior right. And for this cause the law doth adjudge him in by remitter; that is, in such plight as if he had lawfully recovered the same land by suit. For, as lord Bacon observes (Elem. c. 9.), the benignity of the law is such, as when, to preserve the principles and grounds of law, it depriveth a man of his remedy without his own fault, it will rather put him in a better degree and condition than in a worse. *Nam quod remedio destituitur, ipsa re valet; si culpa absit.* But there shall be no remitter to a right, for which the party has no remedy by action (Co. Litt. 349.): as if the issue in tail be barred by the fine or warranty of his ancestor, and the freehold is afterwards cast upon him; he shall not be remitted to his estate tail. (Moor. 115. 1 Ann. 286.) For the operation of the remitter is exactly the same, after the union of the two rights, as that of a real action would have been before it. As, therefore, the issue in tail could not by any action have recovered his ancient estate, he shall not recover it by remitter.

The determination of the law, according to the doctrine of remitter above stated, might seem superfluous to an hasty observer; who perhaps would imagine, that since the tenant hath now both the right and also the possession, it little signifies by what means such possession shall be said to be gained. But the wisdom of our ancient law determined nothing in vain. As the tenant's possession was gained by a defective title, it was liable to be overturned by shewing that defect in a writ of entry; and then he must have been driven to his writ of right, to recover his just inheritance: which would have been doubly hard, because, during the time he was himself tenant, he could not establish his prior title by any possessory action. The law, therefore, remits him to his prior title, or puts him in the same condition as

if he had recovered the land by writ of entry. Without the remitter, he would have had *jus, et seisinam*, separate; a good right, but a bad possession: now, by the remitter, he hath the most perfect of all titles, *juris et seisinæ conjunctionem*. Blackst. Com. b. iii.

REMLINGEN, in *Geography*, a town of Germany, in the county of Wertheim; 9 miles E. of Wertheim.

REMNEY, or REMPNEY, a river of Wales, which rises in Brecknockshire, and, after separating the counties of Monmouth and Glamorgan, falls into the mouth of the Severn, a little below Cardiff.

REMOLADE, in the *Manege*. See CHARGE.

REMOLLAN, in *Geography*, a town of France, in the department of the Higher Alps, on the Durance; 15 miles S.W. of Embrun.

REMON, a township of Upper Canada, on the St. Lawrence; N. lat. 44° 50'.

REMONSTRANCE, an expostulation, or humble supplication, addressed to the king, or other superior, to beseech him to reflect on the inconveniencies, or ill consequences of some order, edict, or the like.

REMONSTRANCE is also used for an expostulatory counsel or advice; or a gentle and handsome reproof, made either in general or particular, to apprise or correct some fault.

REMONSTRANTS, REMONSTRANTES, a title given to the Arminians, by reason of the *remonstrance* they made, in 1610, to the States of Holland, against the synod of Dort, in which they were condemned.

Episcopius and Grotius were at the head of the Remonstrants. And as the patrons of Calvinism presented an address in opposition to their remonstrance, which they called their counter-remonstrance, they received, in consequence of this, the name of "Counter-remonstrants."

REMONTER, Fr. in *Musick*, to new-string an instrument.

REMONTOIR, or REMONTOIRE, in *Horology*, is a species of escapement, in which a secondary spring frequently wound up, or a small secondary weight frequently raised, by means of the maintaining power of a watch or clock, is substituted for the maintaining power itself, for the purpose of urging the balance or pendulum, at short intervals, by more equable impulses than can be constantly effected by the maintaining power alone, as varied by different degrees of friction in the train. When treating of ESCAPEMENTS in general, under their appropriate head, we described three only out of the four classes, and reserved the fourth class, denominated *Remontoir*, till we arrived at our present article.

The first remontoir was invented and made by a German artist in 1600, according to Berthoud; but Huygens, who applied one to his marine clock, described it first in his "*Horologium Oscillatorium*," page 17, and, in conjunction with his cycloidal cheeks, it promised to be a great improvement in his machine; but, as no compensation had at that time been applied to the pendulum, and, as a pendulum is not calculated for a portable machine, particularly on the sea, the utility of the contrivance remained to be proved by subsequent artists. The contrivance under our consideration was a small weight, suspended by an endless well-made metallic chain, that was coiled round the crown-wheel of the escapement, and wound up a small space, at every vibration of a half-second pendulum, by the next wheel, which wheel took its motion from the maintaining power, through the medium of the train, as is usual in common clocks; a ratchet and click, however, were a requisite appendage, to act in the way that the endless cord was applied, in winding up the maintaining power without stopping the motion of the works; such as we have already described in the fifth section of our article

CLOCK-WORK. One half of the weight of the remontoir actuated the escapement wheel during its small fall, and the other half was supported by the wheel that as often raised it again to its original height, while both parts of the folded chain were stretched alike by the said weight. Leibnitz and Dr. Hooke also claimed the originality of a similar invention, but do not appear to have put it in practice, as Sully afterwards did.

Mr. Harrison and Mr. Mudge successively applied remontoir springs, instead of suspended weights, to the escapements of their time-pieces; but, as we have described these under our article CHRONOMETER with sufficient minuteness, it is not necessary to repeat here what we have there detailed of their constructions.

Mr. Cumming and Mr. Nicholson, on the contrary, had recourse again to weights instead of springs in their astronomical clocks; but as these weights did not act during the whole period of the vibration, we have already described them in another class, in the 21st and 38th sections of our ESCAPEMENTS.

After Huygens and Sully, who left no plans of their mechanism behind them for the advantage of future workmen, who had not access to the original machines, Gaudron contrived a remontoir, which performed its office very well, but which was applied in a wrong place, so as not to produce the desired effect of equalizing the impulses given to the regulator; for, instead of being applied to either the balance or balance-wheel, it was made to actuate the wheel preceding the minute-wheel; and, therefore, permitted the irregular friction of a considerable portion of the train to affect the motions of the balance, which fault was avoided in the construction of Harrison's and Mudge's time-keepers: the former of which had its secondary spring wound up eight times in every minute, and the latter had its two remontoir-springs alternately coiled at every corresponding oscillation.

Haley's.—In the year 1796, Mr. Charles Haley, of Wigmore-street, Cavendish-square, London, watch-maker, took out a patent for his invention of a new remontoir spring for a marine time-piece, or chronometer; the specification of which is contained in the 6th volume of the *Repertory of Arts and Manufactures*. Figs. 1 and 2, of Plate XLI. of *Horology*, exhibit, the first a perspective side view, and the second a plan of Mr. Haley's remontoir escapement, as originally drawn; and we propose to retain the same letters of reference as are inserted in the original description. The utility of the invention is stated to consist of its property of communicating an invariable force to the balance, which it does 150 times in the minute, in a train of 9000 beats in the hour. The same letters of reference apply to both figures, and indicate the corresponding parts, which will mutually illustrate each other. A B is the potance plate, and T the balance, the pivots of which, P, X, turn in the cock C and potance D; above the balance T is fixed a pendulum spring S, in the usual way; on the axis of the verge, below the balance, are placed two small steel collets I and K, by friction, having each a ruby pallet projecting a little way beyond their surfaces. I is called the discharging pallet, and K the impelled one; which pallets, together with the pendulum spring, all vibrate with the balance, whenever it is put in motion. E is the balance-wheel of the usual form, moving just clear of the potance plate, and having its pivots supported by the cocks F and G. W V is the axis of the remontoir, which the inventor calls the *renovating* spring; and the three axes, or arbors, just described, stand in the straight line in the direction A B. Below the remontoir spring the round steel pallet M is fixed, so as

just to escape touching the ends of the balance-wheel's teeth in its resting position, and the notch cut in this pallet is to receive the impulse of any tooth of the said wheel that may, at any time, act against it, in passing the line A B. Just above this large pallet is fixed, by friction, another smaller pallet N, of steel, in the form of a snail-piece, and having inserted into it, near the centre of motion, and at right angles, a small ruby pallet, which points directly to the radial end of the notch cut in the large pallet M. A small collet, twisted fast to the axis of the remontoir, just above this snail-pallet, receives the lower end of the spring R, while the upper end is made fast to a piece in the cock H, near W, in a manner similar to that by which the pendulum-spring is fixed. On the arbor of the remontoir, and under the plate A B, is twisted on a pallet I, which may be called the remontoir's impelling pallet, because it gives motion to the balance by striking the pallet K, which the author also called the *impelled* pallet; but is, as we have named it, more properly the *impelled* pallet, because it *receives* the impulse which pallet I imparts. From this detail of the pallets it is obvious, that whenever the balance-wheel impels the large pallet M, the remontoir-spring R, the snail-pallet N, together with its small ruby pallet and impelling pallet I, must have a contemporary motion, and will describe each its respective circle round the common arbor W V.

In *fig. 2*, *a* is a detent-spring, fixed by a screw and steady pin to the upper face of the potance plate, and pointing directly to the axis of the verge, which it nearly approaches. Its shape and mode of being fixed will be better understood from an inspection of *fig. 3*, which gives a side view of it, and from which it will be seen that it is placed high enough above the plate, to come in the way of the discharging pallet I, in each revolution of the latter. Upon the side of the said detent-spring *a*, next to the balance-wheel, a second, but very slender spring is pinned, so that its projecting end exceeds that of the detent-spring, and comes nearer to the balance verge than that of the detent, as represented at *m*, in *fig. 3*. To the detent-spring is made fast a small ruby pallet *r*, seen also in *fig. 3*. The cock *b* is screwed to the potance, and the hole at *i* is tapped to receive the screw *c*, the head of which, being turned towards the centre of the snail, forms a banking for the detent-spring *a*, when struck by the snail-pallet. This screw, *c*, is removed from its due place in the drawing, to avoid confusion; and for a reason, which will presently appear, this double spring *a* may be called the remontoir-detent. On another side of the balance-wheel a second detent-spring *d* is fixed, pointing towards the centre of the remontoir axis, and forming nearly a right angle with the former detent: this second detent is adjusted by the screw *y*. The shape and situation of this second detent, which may be called the locking detent of the balance-wheel, is better seen in *fig. 4*, where its sapphire pallet *s* may be distinguished, against which the tooth 3 of the wheel is supposed to be resting in *fig. 2*. The situation of this pallet *s*, as adjusted by the screw *y*, determines the resting-places of the teeth 1 and 2, while they are equally free from the edge of the pallet M. The locking detent *d* is likewise made fast by a screw to the upper face of the potance plate; and the screw *f*, placed in the cock *e*, but out of its place in the figure, forms a banking to the sapphire pallet *s*, while the screw *g*, in a smaller cock, limits the excursion of the detent-spring *d* itself.

Having described the various pieces of mechanism that compose this remontoir escapement, we will now proceed to explain its mode of acting. First, let us suppose all the parts at rest with the wheel locked by the pallet *s* last described, but that the wheel is ready to move in the direc-

tion of the arrow Z, by the action of the main-spring, through the train, whenever the single detent *d* is by any force impelled back to its banking. Let it also be conceived that, when the snail-pallet N is carried by any means in a direction contrary to that of the wheel till it reaches the pallet *r* of the remontoir or double detent-spring, the remontoir-spring is wound up by such motion, and *vice versa*, and also that when the stroke of the snail-pallet has driven back this detent to its banking, by striking the sloped face of the ruby pallet *r*, the detent will instantly return by the force of its elasticity, and the back part of the said ruby pallet *r* will hold the snail-pallet locked at its return, till some other impulse sets it free again; but that when the unlocking takes place, the spring of the remontoir, now wound up, returns by its own force to its original situation; and that its axis brings back with it its affixed pallets. *Fig. 1*. will be of no use in describing the action of this escapement, but in *fig. 2*. the parts are represented in a state ready to commence motion; the wheel is locked by tooth 3 against the sapphire pallet *s* of the single detent *d*, and the remontoir-spring is wound up, and kept locked by the snail-pallet, resting behind the ruby pallet *r* of the double detent: in this situation let the balance be wound round in such direction that the discharging pallet I may strike the end of the double or remontoir detent outwards, taking both its springs along with it, and thereby unlocking the snail-pallet; at this instant the remontoir-spring R begins to return, and brings all its four pallets with it, and during the return, pallet I, which we have called the impelling pallet, gives its stroke to pallet K on the verge, which we have called the impelled pallet, and through its medium to the balance itself, which now goes on in its oscillation, till the pendulum or balance-spring is wound up; in the mean time the little unlocking ruby pallet, inserted into the snail-pallet near its centre of motion, meets with the extreme end of detent *d*, and drives it back to its banking, thereby setting the tooth 3 of the wheel free from the sapphire pallet *s*; the wheel, being urged by the train, now proceeds till tooth 2 falls into the notch of pallet M, and is checked, experiencing a little recoil; the balance-spring, being now wound up, returns, and also the wheel winds up the remontoir-spring, till it is again locked, by the snail-pallet, after its impulse has driven back the detent: during this action the detent *d* returns by its own spring, and locks tooth 4 of the wheel, at the instant that tooth 2 escapes from the notch of pallet M, and the original situation of all the acting parts is now restored, except that the motion of the balance is not arrested, the slender spring fixed to detent *a* allowing it to pass in the return, without unlocking the said detent; but when the backward oscillation is finished, and the balance returns, the same operation is repeated; *i. e.* the remontoir detent is unlocked, the pallets on its axis are brought back, the impulse is next given to pallet K of the balance, to restore its loss of momentum, and lastly, the wheel is unlocked to wind up the remontoir-spring as before.

The observation we have to make on this ingenious remontoir escapement is this, that on enquiry from good authority we learn, that the theory could never be completely put into practice by the inventor, though he laboured to obtain his object full fourteen years. However well the parts of action were mechanically made, the locking of the remontoir-spring was never certain, for the *first* given to the ruby pallet *r* by the snail-pallet, drove back the detent so far, as frequently to enable the snail to be brought back by the remontoir-spring, before the detent returned to catch it, the consequence of which was, that the pallets of the remontoir axis were all brought back, and the impulse vainly ex-

pended by pallet L, before the pallet K of the balance returned to its place to receive it. Mr. Hardy, however, has lately contrived a species of locking that is quite certain, as well as safe, which we shall presently have occasion to describe.

Breguet's.—We have not been able to ascertain the exact date of the French watch-maker Breguet's invention of a remontoir escapement, but as Berthoud has placed it after Hales's in his "Histoire de la Mesure du Temps," we must conclude that it is of more recent origin. The mechanism is so complex, that the description given in the French work is divided into three parts, which plan we propose to follow.

Figs. 5. and 6. of Plate XLI. of Horology, will suffice to explain the different parts of Breguet's remontoir; *fig. 5.* being a plan of the whole, and *fig. 6.* exhibiting a perspective view of such parts as could not be well understood without such representation. The first portion of the mechanism consists of two wheels of unequal numbers of teeth, with their planes in contact, and revolving on one common arbor concentrically, namely, the wheel B B', and the wheel D, the first having many teeth and a larger diameter, and the second having few, for a reason which will appear hereafter: these wheels are actuated by a pinion g, connected with the train, and having just so many leaves as there are teeth in the large wheel B B', contained in the space between two contiguous teeth of the small wheel D; on the arbor of this pinion, near the pivot, is inserted a fly with unequal arms, represented by the letters *ig b* in both figures, the longer arm of which, *g b*, is armed with a piece of steel of peculiar shape, seen in *fig. 6.* A spring-detent *r F*, made fast to the cock at *r*, lies at right angles to the fly, when in a state of rest, and has a ruby pallet V at about one-third of its length from its interior end, which stops the fly by opposing its end *b* near *r*, and consequently prevents the train from urging the double wheel, so long as no force unlocks the pallet from the end of the fly; but if any impulse happen to bend the detent in a direction towards the pinion *g*, then the ruby pallet slips through a notch made in the steel part of the fly, and the fly makes an entire revolution, while the pinion revolves and urges the large wheel the space of as many teeth as the pinion contains; that is, a space corresponding to the distance between two contiguous large teeth in the small wheel, which wheel also moves the same quantity, before the fly is again opposed and stops.

The second portion consists of the following parts; a spring G, curved at the interior, or moveable end, serves at the same time for a remontoir-spring, and also for a pallet to give the impulse to the balance; it has consequently a heel-piece *n*, by which it is urged into a state of tension by the small wheel D, at every revolution of the fly, and also a ruby pallet *m*, with a locking notch cut in it; a H, made fast at *a*, is a detent-spring, placed nearly at right angles to the spring G, and having a slender spring N made fast to its side; this detent-spring carries a small ruby *p*, which locks into the notch of the piece *m* in the spring G, when this is in a state of tension. Another ruby, inserted into the extreme end of the detent *a H* at *s*, is so placed, that the slender spring N can move from right to left without impediment, but when urged in an opposite direction against the ruby *s*, it takes the large or detent-spring along with it, and unlocks the remontoir-spring G, by removing the small ruby *p* from the notch of *m*. The detent-spring H has at its extreme end a claw, against which the ruby *m* falls when this detent escapes back from a tooth of wheel D; and this claw has a pin in it, against which the slender spring N rests; again, at the extreme end of the slender spring N are fixed two parallel chamfered plates, so contrived,

that any pressure made on the upper slope, or inclined edge, will depress the spring, but a similar pressure made on the under slope will elevate it again, the downward pressure being employed to disengage the ruby *m* from the claw, and the contrary.

The third portion consists of the pieces or pallets K and *b*, borne by the superior end of the verge of the balance, and fixed at a quarter of a circle from each other. When the oscillation of the balance is from right to left, or in the direction from *b* to K, the unlocking pallet piece K, in its motion, bends the slender spring, and passes over it, but as the pallet *b* is placed above the plane of the wheel B B', and under the spring H, this oscillation from right to left is performed in freedom, except that the slender spring N requires to be a little bent out of the way; but when the oscillation is made from left to right, the pin at H presses this slender spring against the ruby *s*, the spring H then gives way, and bending, allows the ruby *p* to escape from the notch at *m*, and the spring G, being unlocked, is at liberty to perform its office, which we now proceed to describe.

The action of these three portions of the mechanism may be thus explained: at the instant that the ruby *p*, in the detent *a H*, is disengaged from the notch at *m* in the remontoir-spring G, the pallet *b* of the balance is found pointing towards the common centre of the wheels, and ready to receive an impulse from the extreme end *q* of the curved part of the remontoir-spring G, which end now gives its stroke to the balance through the medium of pallet *b*; immediately after which stroke, the same end *q* proceeds till it falls on the end F of the fly's detent, to which it now gives a push, and remains quiet; this push unlocks the fly, as has been before explained, and an entire revolution is immediately performed by it, while its pinion *g*, now at liberty to advance, urges on the double wheel, till another tooth in the small wheel, catching the heel-piece *n* of the remontoir-spring, puts this spring again into a state of tension; and the ruby *p*, falling into the notch of *m*, locks it as before, the balance in the interim completing its oscillations: and in this manner the operation is repeated.

De Lafon's.—In the year 1801, the Adelphi Society for the Encouragement of Arts, &c. rewarded Mr. John de Lafons with thirty guineas for his invention of a new remontoir watch escapement, which comes next under our notice. *Figs. 1 and 2 of Plate XLII. of Horology,* are a plan and section of this escapement, as given by the inventor in the Society's Transactions of the year above-mentioned. In both these figures, A is the escapement wheel; B, the lever-pallet on an arbor with fine pivots, which has, at its lower end, the remontoir spiral spring C, fixed with a collar and stud in the usual way; D is the pallet of the verge, having a roller turning in small pivots, for the lever-pallet to act against without friction; at E are the pallets for discharging the locking, with a roller between, containing a small notch; F is the arm of the locking pallets, continued at the other end beyond the centre of motion, to preserve the equipoise, and having studs and screws for adjustment of the banking; *a* and *b* are the locking pallets, being portions of circles fastened on an arbor, turning on fine pivots at the midway between the pallets; G is the triple fork, at the end of the arm of the locking pallets. In *fig. 1*, tooth 1 of the wheel having caught the interior end of the lever-pallet B, has urged it forwards and wound up the remontoir-spring, and the instant that the verge pallet D comes nearly in contact with the remote end of the lever-pallet, the discharging pallet E, taking one prong of the fork, removes the arm F, thereby relieving the tooth 3 from the convex part of the claw *a*, that locks the wheels.

The wheel now advances a little way, just enough to allow the interior end of the lever-pallet to pass back again, as urged by the spiral spring, while the remote end of the said lever gives an impulse to the balance, through the pallet D; the tooth 4 is then locked on the concave side of the locking claw *b*, and the interior end of the lever-pallet partly supports the following tooth; in this situation the oscillation is finished, and on the return of the balance pallet E, striking the prong of the fork in a contrary direction, again unlocks the wheel from claw *b*, while the force of this wheel is partly suspended by the end of the lever-pallet; being now at liberty, the wheel proceeds to wind up the remontoir-spring again, till another tooth falls on the claw *a*, now brought inwards, when the operation is completed, and the pressure of the inner end of the lever pallet again its contiguous tooth again relieves the claw *a* from a part of the pressure of the wheel, and thereby renders the unlocking as easy as before, when claw *b* was unlocked. This escapement appears to us an improvement on Haley's, both as to its simplicity and safety of locking, and the inventor proposes a still further simplification, by substituting a straight remontoir-spring for the spiral one, particularly in time-pieces intended to remain in a stationary situation, where the weight of the spring would form no objection; but it does not appear that such construction was ever adopted. The simplicity of the locking of the remontoir-spring by the wheel itself, where this spring and the maintaining power mutually re-act, requires, as might be foreseen, an unusually strong maintaining power, which is, perhaps, one of the greatest objections to this mode of applying the remontoir; unless, indeed, what was remarked by the society's committee be true, that the balance must vibrate in a large arc before the piece will continue to perform.

Maffey's.—Mr. Edward Maffey, of Hanley, in Staffordshire, received a reward of fifty guineas from the Adelphi Society, in the year 1803, for his invention of two different clock escapements, one of which we have already described, under our article ESCAPEMENT, as being without a verge; and the other we shall make the subject of our present section. Fig. 3. of Plate XLII. represents so much of Maffey's remontoir escapement as is sufficient to explain all the essential parts; in which A is the swing-wheel; B, C, are two detached pallets, moving on separate arbors, at opposite sides of the swing-wheel; B is seen urged by the remontoir-spring E, by the aid of a tail-piece fixed on the arbor of pallet B, which receives the action; and the other pallet must be conceived to have a similar spring and tail-piece, which cannot easily be represented in the drawing; F is the verge bearing two arms without pallets, which press under the pins of the detached pallets, and raise them alternately, at each vibration of the pendulum, from the teeth of the swing-wheel, which had been previously impelled by the maintaining power, and K is the pendulum suspended in the usual way, and having a crutch to communicate its force to the verge at the moment of withdrawing the pallets. All, therefore, that the pendulum has to do, is, to disengage the pallets from the teeth of the swing-wheel that locks against the inclined planes of the pallets; for the remontoir-spring then opposes the ascent of the pendulum, and aids its descent, by means of the connection between the pins of the pallets and the arms of the verge, which must, from the nature of the construction, continue in contact during a large portion of each excursion of the pendulum. It is not stated in the author's account (Trans. Adel. Soc. vol. xxi.) at what part of the arc of vibration the pendulum unlocks

either of the pallets, but it seems to us capable of being made to effect this office at its point of *greatest velocity*, if it does not do that as now constructed. An attention to this particular is of the utmost importance in any escapement, since the natural law of gravity is the least deranged, when any force is given, or taken away, when the pendulum is at the *lowest point* of its arc, for the velocity it has at *that point* determines the height to which the ball shall rise; but any addition or diminution of the pendulum's momentum, beginning at any other point of the arc, either adds to, or diminishes the natural length of the vibration, and injures the isochronism. Besides, a spring commencing both its accelerating and retarding influence at the point of the pendulum's greatest velocity, acts, not only by a law commensurate with the law of gravity, but their various forces, thus exerted, are contemporary, and, therefore, act together as one; a consideration which never should be lost sight of in the construction of an escapement of any denomination. The principal advantages that the author seems to insist on in this escapement, are, that the friction is diminished at the acting parts of the pallets, the impulse being given by a direct *push*, without, or with very little, sliding motion; and that a certain regular momentum is kept up in the pendulum, independently of any variation which may occur in the wheel-work, or in the acting part of the pallets during the short time of unlocking; but, what is the principal object of such a contrivance, he has not stated, perhaps not considered, how this *certain regular momentum* is, or ought to be, *modified*.—Indeed, in speaking of his other escapement without arbors, he says, that one of its advantages over this is, that during a *part* of the vibration the pendulum is *disengaged*; from which remark, it should seem, that he thinks the constant action of this remontoir-spring, however modified, an objection to be avoided.

Antis'.—In vol. xxiii. of the Transactions of the Society last mentioned, it is stated, that Mr. John Antis of Fulneck, near Leeds, sent this society a model of a new clock escapement in 1805, with a corresponding description, for which a reward was voted him of twenty guineas. The model is deposited in the room at the Adelphi appropriated for the reception of models, but as the description is not published in the Transactions of the Society, nor an engraving given of the model, we must infer, that the contrivance either is not new, or is not of such importance as to merit the particular notice that has been given by them to the inventors of like contrivances, who both preceded and followed him. Indeed, in the letters of Mr. Antis to the Society, published with their account of the rewards, it seems that two escapements were sent them, one a *detached* one, and the other, one that "*would equalise the power of the impulse*," which must, therefore, have been of the *remontoir* description; but he confesses that these contrivances by him "*may have been practised before*." With respect to the latter escapement, he remarks, what is worthy of being recollected by clock-makers in general, that, by its means "*a spring-clock will be as perfect as one which goes by weight, and more so if the latter has no remontoir*." Should any of our readers have a wish to see and examine Mr. Antis' productions, which, he acknowledges, are done in a rough manner, and under disadvantageous circumstances, but which may not be the less ingenious on that account, there will be no difficulty in gaining admission to the model room, where the original work is preserved with a view to public inspection, provided the applicant be properly introduced.

Mendham's.—It frequently happens that considerable
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improvements are made in mechanical contrivances, by men whose principal employment has no connection with the art to the improvement of which they contribute; this was probably the case with Mr. Antis, and is confessedly so with Mr. Mendham, who was rewarded with the silver medal of the Adelphi Society, in the year 1807, (see vol. xxv.) for a remontoir escapement for a chronometer, which next offers itself for our description. *Figs. 4, 5, and 6, of Plate XLII.* are copied from the plate given by Mr. Mendham, *fig. 4.* being a section of the whole escapement, *fig. 5.* a plan of the wheel and locking pallet, and *fig. 6.* a detached view of the pallets and their common arbor. The letters *a a*, in *fig. 4.* are the two plates of the frame that contain the works; *b* is the balance, nearly of the usual shape and size; *c* is the pallet that acts with the wheel, and *d* its arbor; *e* is the locking single spring; and *f* is the unlocking pallet in the form of a pin, attached to *c*, and seen better in *fig. 6.* At the lower end of arbor *d* is placed *g*, the remontoir-spring, that gives force both to the small pallet *f*, and also to the perpendicular pin *h*, that forms a part of the pallet *c*. The arbor *d* does not ascend above the upper plate of the frame, but the pin *b* does, and the plate being formed, as we suppose, like a rim, *b* is permitted to move in the vacant space within the rim, and sufficiently high to fall in the way of the finer pin *i*, inserted into and under the balance. The balance *i* has its verge immediately over the upper pivot of arbor *d*, point to point nearly, so that the motions of the balance-pin *i*, and of the pin *b*, that impels it, may be concentric. The cock *k* supports the upper pivot of the verge, and also holds the outer end of the balance or pendulum-spring. The action of these parts may be thus explained; before motion is given to the balance, we must conceive its pin *i* to be in contact, or nearly in contact with the pin *b* of the pallet *c*, and it must be remembered, that the wheel rests on the pallet during the vibration of the balance: suppose now that the remontoir-spring *g* is in the act of being wound up by the balance-wheel, as actuated by the train; and that the pin *i* of the moving balance has kept in contact with the impelling pin *b*, borne by the arbor of the remontoir, it is evident, that the force of the remontoir-spring is here opposed to the momentum of the balance and at last stops it, thereby forming a banking of an unlimited extent; but the tooth of the wheel in contact with pallet *c*, at the point of shortest radius, assists to oppose or wind up the said spring during a space of one-fifth of a circle, till the tooth has passed and the wheel is locked; on the return of the balance the remontoir-spring exerts all its force on the balance, but without a jerk, the pins *i* and *b* being already in contact, till it comes to the stop; the balance then maintains its motion, and the small pallet *f* having unlocked the wheel by forcing out the detent, the next tooth of the wheel falls on the pallet *c*, and waits the return of the balance, when the same operation is repeated.

Mr. Ramfay of Islington was consulted on the merits of this escapement, and, on considering its properties, he gave a written report to this effect; that the impulse is here given to the balance without friction, exactly as in Mudge's chronometer; and that the remontoir is wound up by the maintaining power in a similar way, except that the shape of Mudge's tooth limited the quantity of tension of the spring, which here depends on the amount of the maintaining power; but that this escapement, having but one remontoir-spring, is more simple than Mudge's, and allows an unlimited arc of vibration, which advantages compensate the foregoing disadvantage in the shape of the tooth; and lastly, that it is superior to the detached escape-

ment, inasmuch as that it gives the impulse without friction.

G. Prior's.—The silver medal and twenty-five guineas were voted to Mr. George Prior, junior, of Otley, in Yorkshire, in the year 1809, by the Adelphi society (vol. xxvii.) for his invention of a new clock escapement, in which an impelling (not however called a remontoir) spring actuates, or professes to actuate, the pendulum at each alternate vibration. The account, particularly of the action, as printed in the society's Transactions, seems to us so extraordinary, that we beg leave to transcribe it verbatim, in order to make some remarks on it, that may enable the reader to judge of the escapement's peculiar qualities, or at least of the manner in which they are described. *Fig. 7.* of *Plate XLII.* already referred to, contains enough of this escapement to answer the purpose of the description in question, and therefore we will omit the references to *fig. 1.* in the original plate, and attend to its *fig. 2.* only. "*Fig. (7)* is a back view, which is supposed to be taken from behind the clock; *a* represents the axis of the swing-wheel, or last wheel of the train of the clock; *b d* is the swing-wheel fixed upon it, having thirty serrated teeth; it is turned round, in the direction from *b* to *d*, by the maintaining power of the clock; *g* is a spring-detent, which locks against one of the teeth of the swing-wheel, and this prevents its running down by the action of the maintaining power; *h* is another spring-detent, which is called the impelling spring; when left at liberty, it unlocks the former, by pushing against the end of the small arc *e*, fastened to the detent *g*, and thus removing the end of the detent which obstructed the wheel's motion; *l* is the rod of the pendulum, suspended by a cock screwed to the back plate of the clock; a small piece of brass, *k*, projects at right angles from the impelling spring *h*, so as to intercept the pendulum rod in its vibration, and at this place a small screw is put through the pendulum-rod *l*, the point of which moves the impelling spring back: a small pin is fixed to the frame, in a line between the point of suspension of the pendulum, and the centre of the swing-wheel, against which the impelling spring stops when at liberty.

"Supposing the pendulum to be vibrating backwards and forwards, and the wheel locked as in the figure, the pendulum swinging from *m* to *n*, the impelling spring *h* follows by its elasticity, until the pendulum *l* arrives at its perpendicular (or lowest point of its arc); at this period the impelling spring comes to rest against the end of the arc *e*, which it pushes back, so as to release the tooth of the wheel from the detent-spring *g*; the wheel now moves round a very small space before it meets the end of the impelling spring *h*, and is stopped thereby; in the mean time the pendulum continues its motion the extent of its vibration towards *n*, when it returns, and arriving at the perpendicular, it meets the impelling spring *h*, and carries it along with it, until the tooth of the wheel which rests against it escapes from the end of it, and another tooth of the wheel comes to rest against the spring-detent *g*. The succeeding vibration of the pendulum repeats the same operation." This is the whole account, from which the reader is induced to believe that the pendulum, and impelling spring *h*, act and re-act on each other *ad infinitum*, without any aid from the maintaining power through the medium of the wheel, which is never said to raise, or otherwise to move the impelling (or remontoir) pallet, in order that it may, in its turn, impel the pendulum by its acquired force. Again, it is said, the impelling spring unlocks the detent *g* when it arrives at the perpendicular, or nearly, if not quite, at the point of its quiescence, where it has *no force*, and from that point, not the

the wheel, but the pendulum unbends it into a state of tension, to resume its operation; that is, the pendulum raises the spring, that the spring may drive the pendulum back again; and thus the vibrations are maintained without the aid, and consequently without the necessity, of either a maintaining power or train; and what is equally extraordinary, the impelling spring locks the wheel by its *refillance*, near the perpendicular line (within the space of one tooth), where it has almost the smallest force, or nearly the same small force that it has when it *unlocks* the *detent*. According to this account, even supposing the action of the wheel on the remontoir pallet to be *omitted*, the pendulum is under the influence of the impelling pallet during nearly the whole of one excursion, and free from it in the other. The model, however, is said to be preserved in the society's room, and will explain itself.

G. Prior's improved.—Mr. George Prior, jun. again presents an improved remontoir escapement for a clock to the society we have repeatedly had occasion to name in this article, in the year 1811 (vol. xxix.), and again receives a reward at their hands, of twenty guineas, for his improvement. The description given of this escapement, and of its action, is sufficiently clear, and the alteration made in the construction is in many respects an improvement, though we shall take occasion to shew, in our remarks on it, that it is still liable to objections. In the plate last referred to, *fig. 8.* contains the original *fig. 1.* which will explain the account with sufficient precision. “The swing-wheel A,” says the author, “has thirty teeth cut in its periphery, and is constantly urged forwards by the maintaining power; C, D, are two spring-detents, catching the teeth of the wheel alternately; these are, at the proper intervals, unlocked by the parts marked 2 and 3 upon the pendulum-rod H, intercepting small pins *a, b*, projecting from the detents, as it vibrates towards the one or the other; E is the renovating or remontoir-spring, fixed to the same stud, F, as the detents; it is wound up by the highest tooth of the wheel, its position, when unwound, being shewn by the perpendicular dotted line. This being the case, suppose a tooth of the wheel caught by the detent D, which prevents the wheel from moving any farther, and keeps the renovating spring from escaping off the point of the tooth; in this position the pendulum is quite detached from the wheel: now if the pendulum be caused to vibrate towards G, the part of it marked 2 comes against the pin *b*, projecting from the renovating spring E, and pushes this spring from the point of the wheel's tooth; on vibrating a little further, it removes the detent D, which detained the wheel, by the part 3 striking the pin *a*, which projects from the detent; the maintaining power of the clock makes the wheel, thus unlocked, to advance, until it is detained by a tooth resting upon the end of the detent C, on the opposite side; by this means the renovating spring will be clear of the tooth of the wheel as it returns with the pendulum, and gives it an impulse by its pin *b* pressing against the part 2 of the pendulum, until the spring comes to the position shewn by the dotted line, in which position it is unwound, and rests against a pin fixed in the cross-bar of the plate; the pendulum continues vibrating towards I, nearly to the extent of its vibration, when the part 1 meets the pin in the detent C, and removes it from the wheel and unlocks it; the maintaining power now carries it forward, pushing the renovating spring E before it, until another tooth is caught by the detent D, which detains the wheel in the position first described.” Agreeably to this description, the pendulum is opposed in its ascent, and accelerated in its descent, in one of its excursions from the centre, or perpendicular line, by both the impelling spring

E, and detent D, after it is unlocked, though not the whole distance; but is alternately accelerated and retarded in the other excursion by the detent C alone, and only after the unlocking; these unequal checks, given at different parts of the arc of vibration, we apprehend, are by no means favourable to the natural isochronism of the pendulum.

Hardy's.—Mr. Hardy, chronometer-maker, of Ceppice-row, Clerkenwell, London, whose ingenious improvements in clock and watch-making have placed him high in public estimation, on contemplating Mr. C. Haley's failure in the locking of his remontoir detent, contrived a remedy which fully answers its purpose, and which, on that account, merits our particular notice.

Fig. 7. of *Plate XII.* of *Horology*, represents the plan of Hardy's new remontoir escapement, which, though it appears to differ considerably in construction from Haley's, yet resembles it so much in its action, as well as principle, that we will put the same letters of reference to the same corresponding parts, in order that the reader who has perused our description of Haley's remontoir with attention, may the more clearly comprehend our description of Hardy's, and perceive in what the improvement consists. As in Haley's construction, T T represents the balance, or rather the place of the balance not seen; E the escapement, or balance-wheel; P the pivot of the verge; S the balance-spring, suspended as usual; K the impelled pallet; I the unlocking pallet of the remontoir; N the remontoir detent, or locking pallet, on the same axis with *a*, the arm of the slender or unlocking spring, which lies parallel with it; *n* the cock, taking the pivot of the remontoir detent's arbor, and also the upper end of its spiral spring; *c* the head of the banking screw, and *i* its stud; H the cock that takes the pivot of the remontoir, or cylindrical spring at W, and also one end of the said spring, represented by the small circle at R; L is the impelling lever or pallet, for giving motion to the pallet K of the balance; M is a lever, instead of the notch in Haley's large circular pallet, by means of which the wheel winds up the spring R of the remontoir; O is a lever, in place of the small ruby unlocking pallet of Haley, fixed to the final; *d* is the spring-detent of the wheel, and *s* its ruby, or sapphire pallet, on which the wheel is locked, *f* and *g* being the banking screw and its stud, and *y* the place where it is fixed by a screw on the potence plate; and lastly, the fectoral piece Q, in which the improvement chiefly consists, is the addition introduced for rendering the locking of the remontoir-spring, when wound up, both certain and secure. The acting faces of the pallets *s*, M, K, N, and of the circular portion of Q, are of ruby, or other precious stone nicely polished, and are properly shaped for their respective offices. From this description of the mechanism before us, it will be perceived that the double spring *a*, and the detent with a claw pallet at N, are both fast to the arbor of the spiral spring, which gently presses the detent at all times down upon the fectoral piece Q, thereby preventing its being thrown back from its position for locking, as was the case with Haley's remontoir detent. It will also be seen that the arbor W, of the remontoir-spring R, has the said fectoral piece, the impelling lever L, the lever M impelled by the wheel, and the discharging lever O, all fast to it at different heights, the two first being above, and the two last below, so that when one of these four pieces is moved out of its first situation by any external force, they all move together, as do also the remontoir detent N and its spring *a* on their common arbor, and as do likewise the pallets K and I on the verge of the balance. These particulars being understood, and that levers in Hardy's construction are

used

used for pallets in several instances, we may proceed to explain the action of the different parts, and to shew how they produce the desired effects of producing equable impulses on the balance at all times, and of effecting certain and secure locking of the remontoir-spring. In the figure before us, tooth I of the wheel has just proceeded far enough, by the action of the main-spring and train, to wind up the remontoir-spring, and its detent N, urged by its own spiral spring against the curved face of the sectoral piece, after sliding smoothly along it, has locked it; that is, by opposing it at right angles, prevents its return, which would take place when the wheel leaves the arm M, or, which is the same thing, when the remontoir-spring, on the same arbor with this arm, is wound up. The balance is now supposed to have commenced its motion, carrying the pallets K and I outwards from the wheel, but the small pallet I has not yet arrived at the slender spring of the remontoir detent, though it is approaching it; the slender spring, however, soon yields to the outward impulse of this small pallet, without disturbing its arm or the detent N, therefore the remontoir-spring remains locked: at the return of the balance, which takes place when its spring is wound up, the said little pallet I displaces not only the slender spring but its arm also, which lies next towards the wheel, the one not being liable to move in this inward direction without the other; the consequence is, that the detent N is now lifted by its connection with the arm of the slender spring, and at that instant the remontoir-spring, being wound up, and at liberty to act, throws back the sectoral piece Q nearly its whole breadth, but not quite, for the claw of the detent in question rests on the curve of the sector during the motion we have described, till the unlocking lever O strikes the end of the single detent-spring d, and forces the ruby pallet s out of the wheel, which wheel instantaneously resumes its motion from the train, and meeting with lever M winds up the remontoir-spring a second time; in the mean time the impelling lever L has given its impulse to the pallet or lever K, and consequently to the balance, which has thus had its momentum increased; and on its returning vibration exactly the same process is repeated. Thus the force of the maintaining power is expended in winding up at each alternate oscillation the remontoir-spring, which spring, so reinforced, impels the balance in its turn by quantities of force that are always the same, whatever may be the irregularities of the force transmitted through the train that winds up the remontoir-spring; therefore, properly speaking, the remontoir-spring is the maintaining power that restores, at each alternate oscillation, the loss of momentum that the balance has experienced from the resistance of the air, and friction of the parts in action. This escapement is, notwithstanding, of the detached kind, seeing the balance performs the greatest part of its oscillations without any connection of even the auxiliary force derived at intervals from the remontoir-spring; and a chronometer of this construction, made by Hardy for his royal highness the duke of Suffex, answers the maker's most sanguine expectation, and will probably become a model for other makers when its merit is proved, and made public. The same artist has made several experiments on the same principle, with this difference, that the remontoir-spring is retained by the lever resting on the tooth of the wheel, in place of being locked by the sectoral piece, as in the one before us.

Besides the preceding escapement, Hardy invented one for the astronomical clock he made for the Royal Observatory at Greenwich, which at first sight appears to resemble Maffey's and Prior's improved one, with spring pallets, but on close examination we discovered that it has the fol-

lowing desirable properties peculiar to itself: 1st, it gives the impulse not only from remontoir-springs, but strikes and unlocks the two separate detents alternately, at the instant when the pendulum has the *greatest velocity*; and, 2dly, the accelerating and retarding power imparted to the pendulum co-operates with the force of gravity, thereby deranging the natural law of gravity as little as possible. We feel not at liberty to enter more minutely into the description of this escapement, because we understand its inventor proposes giving an account of his machine himself, to be read before the Royal Society, as constituting the companion to Troughton's transit circle, already described by the astronomer royal. We have permission, however, to subjoin the rate of the clock in question for three quarters of a year, as taken at the Royal Observatory, which will afford the best proof of its pretensions to public notice. We have further to add, that the inventor has applied the same principle of movement to a chronometer of a large size, in which the balance has two metallic rods to adjust it for temperature, in place of the metal being fluxed on the rim of the balance, as is common. See COMPENSATION.

Trial of Mr. Hardy's clock at the Royal Observatory at Greenwich in the year 1811.

	Daily Rate.	Mean of Thermometer.
April 12 to May 13 - -	— 0.86	61
May 13 to June 9 - -	— 0.74	63
June 17 to July 12 - -	— 0.74	64
July 18 to August 17 - -	— 0.83	68
August 17 to September 14 -	— 0.77	65
September 14 to October 4 -	— 0.61	60
October 17 to November 17 -	— 0.60	51
November 17 to December 10	— 0.50	46
December 10 to December 30	— 0.47	39

From the above stated authentic document it appears, that for the nine months of trial, and in opposite extremes of temperature, the daily rate never varied quite *four-tenths* of a second; and when the quantity of mercury proper for the compensation of the pendulum is exactly ascertained, it may be expected that the performance will be still more accurate; seeing that the deviation in the rate depends evidently on the change of temperature, and not on the escapement.

REMORA, in *Natural History*, the *sucking-fish*; a little fish, resembling a herring, called by the Greeks *echeneis*, famous for sticking to the sides of ships. It belongs to the genus of *echeneis* and class of *thoracici* in the Linnæan system.

Its characters, according to Artedi and Linnæus, are these: the branchiostegæ membrane on each side contains about ten bones; the head is thick, depressed, naked, and marked on the upper side with transverse rough striæ; the body is oblong, roundish, and naked, but somewhat compressed; the back-fin is oblong, and placed very far toward the tail; its under jaw is longer than its upper; it has a great number of teeth in both jaws; the colour of its body is hoary, and it has seven fins; two pectoral ones, two ventral ones placed farther from the snout than the pectoral ones, one at the anus, one on the back, and one at the tail; the striæ of the head are from eighteen to twenty-four in number, they are rough and transverse, but are divided as it were into two series by a middle longitudinal line. By means of these striæ or ridges the fish can fix itself to any animal

animal or other substance, and has often been found adhering to the sides of ships and the bodies of sharks, &c.

Linnaeus enumerates two species of the echeneis; the remora and neurates: the former has a forked tail, and eighteen striz on the head; the latter has an entire tail, which is longer than that of the former, twenty-four striz, a larger body, and sharper fins. They are both inhabitants of the Indian ocean. The remora is much talked of by the ancients, who, as we find from Pliny, lib. ix. cap. 25. lib. xxxi. cap. 31. unanimously believed it had the force to stop a vessel in full sail, or a whale in swimming; and hence called it *remora*, a *remorando*. (See *Ælian's Hist. de Animal.* lib. ii. cap. 17. Plutarch. *Sympos. lib. ii.*) But Mr. Cateby observes, that even several of those fishes together can do no more than shells or corals, and other foulnesses of the same bulk, which make a ship sail somewhat the slower. And in the same manner only they may be some small hindrance to a whale. The author last mentioned assures us he has taken five of them off the body of a shark. Vide *Phil. Trans.* N^o 438. p. 113.

REMORA, among Surgeons, is also an instrument used for setting broken bones.

REMORA *Mutiani*, in *Natural History*, a name given by some to the genus of shells called *concha venera*, and *porcellana*. See PORCELAIN Shell.

REMOTION, REMOTIO, in *Rhetoric*, the same with what is otherwise called *metastasis*.

REMOVAL of the Poor. See POOR.

REMOVELLE, in *Geography*, a town of France, in the department of the Vosges; 5 miles E. of Neufchateau.

REMOVING *Obstructions to Tillage*, the means of removing stones and any other substances that may be in the way of the plough.

The operations which are to be performed in these intentions are of several different kinds, as the removing of various forts and states of stony matters, both from above and below the surface of the lands; the eradicating and destroying different kinds of woody materials of the tree, root, and plant forts, the taking away of the superabundant wetness; the destruction of many aquatic vegetables, and some others. See LAND, STONE, TILLAGE, and WOOD.

REMOULIN, in the *Manege*, is used to denote a star upon a horse's forehead.

REMOULINS, in *Geography*, a town of France, in the department of the Gard, and chief place of a canton, in the district of Uzès; 7 miles S.E. of Uzès. The place contains 905, and the canton 4758 inhabitants, on a territory of 135 kilometres, in 8 communes.

REMOUNT, in *War*. To remount the cavalry, or dragoons, is to furnish them with fresh horses, in lieu of such as have been killed or disabled in the service.

REMPHAN, in *Antiquity*, the Egyptian name for the planet Saturn. Some think that remphan was the moon, others Mercury and Mars, and others the sun. See CHIRON.

REMPPLY, in *Heraldry*, something filled up. The term is chiefly used to denote, that the chief is quite filled up with a square piece of another colour, leaving only a bordure of the proper colour of the chief about the said piece.

REMPORETTY, in *Geography*, a town of Hindooftan; 30 miles N. E. of Travancore.

REMS, a river of Wurtemberg, which runs into the Neckar, 4 miles N.W. of Waiblingen.

REMSA, or REMISSAM, a town of Saxony, in the lordship of Schonburg; 2 miles N.N.E. of Glauchau.

REMSCHIEDT, a town of the duchy of Berg; 2 miles S.W. of Lennep.

REMSEN, a township of America, in Oneida county, New York, E. of Leyden and adjoining it.

REMUNGOL, a town of France, in the department of the Morbihan; 7 miles S. of Pontivy.

REMURIA, among the Romans, a festival instituted in honour of Remus by his brother Romulus. See LEMURIA.

REMUZAL, in *Geography*, a town of France, in the department of the Drôme, and chief place of a canton, in the district of Nyons; 6 miles N.E. of Nyons. The place contains 514, and the canton 3724 inhabitants, on a territory of 272½ kilometres, in 17 communes.

REMY, a town of France, in the department of the Oise; 6 miles N. of Clermont.

REN, a town of Russia, in the government of Novgorod; 16 miles S.E. of Ultiuzna.

RENAISON, a town of France, in the department of the Rhône and Loire; 6 miles W. of Roanne.

RENAIX, a town of France, in the department of the Scheldt, and chief place of a canton, in the district of Audenaerde. The place contains 9499, and the canton 14,683 inhabitants, on a territory of 70 kilometres, in 6 communes.

RENALIS, RENAL, in *Anatomy*, an epithet applied to the parts belonging to the kidney; as to the artery and vein of the organ, also called *emulgent*, of which the former comes from the aorta, the latter joins the inferior vena cava; see ARTERY and VEIN: to the plexus of nerves derived principally from the ganglia of the great sympathetic; see NERVE: and to the small bodies placed above the kidneys, called the *renal capsules*. See also KIDNEY.

RENALIS Lapis, in *Natural History*, the name given by many authors to a sort of siderochitum, or crullated ferruginous body of that kind, containing a nucleus of a different matter from that of the crulls. It is found about Prague, and in some other places, lying near the surface in strata of a yellow clay. Its usual bigness is that of a ripe peach, and its crulls are of a dusky ferruginous brown colour: and its internal nucleus of a pale yellowish-green, composed of a marley earth, and usually of a kidney-like shape, whence its name.

RENASSAU, in *Geography*, a town of Hindooftan, in Dowlatabad; 114 miles N.W. of Hydrabad. N. lat. 18° 30'. E. long. 79° 10'.

RENATHIA, a town of Asiatic Turkey, in Carmania; 10 miles S.W. of Satalia.

RENAU D'ELISAGARAY, BERNARD, in *Biography*, a distinguished engineer and naval architect, was born in the province of Bearn, in the year 1652. He was at an early age instructed in the mathematical sciences, and was observed not to read a great deal, but to think most profoundly, and as he advanced in years, he was capable of thinking upon the most abstruse subjects, as well in the midst of company, as in the closet. One of the first books that attracted his attention was Malebranche's "*Recherche de la Verité*," and, it is said, it made such an impression upon him, that nothing could efface it through the whole of life. It gave him a full conviction of the truths of religion, and preserved his morals pure and uncorrupted. In 1679 he was placed with the count de Vermandois, admiral of France, as his instructor in naval affairs. When, by the royal command, conferences were held to determine upon a plan for bringing to perfection the construction of vessels, Renau was called upon for his opinion; and at length the systems of Du Quesne and that of Renau were alone left for consideration, and to the honour of Renau, then young and almost unknown, his plan was adopted, and he himself was sent to Brest and the other ports to put it in execution.

In

In 1680, the Algerines having declared war against France, Renau proposed the bombardment of Algiers, for which purpose he conceived the idea of bomb-vessels, which were as yet unknown. This was at first regarded as visionary; but reliance being placed on his talents, he was permitted to make the trial, and he brought five of these vessels before the town, where, under the command of Du Quesne, the bombardment was executed with complete success. In 1684 he was employed, as engineer, at the bombardment of Genoa; from this place he went to join Vauban, who was fortifying the frontiers of Flanders and Germany, and he contracted an intimate friendship with that great man. In 1688 he accompanied Vauban to the siege of Philipsburg, and afterwards conducted, or was present, at some other sieges; yet in the midst of these active services he found leisure to attend to his studies, and published in 1689 his "*Theorie de la Manœuvre des Vaisseaux*;" some of the propositions in this work were contended by the celebrated Huygens. In this same year he endeavoured to prove, by argument, that the navy of France might be rendered capable of making head against that of England and Holland united, and his observation produced such an effect upon the government, that an order was made to change all the 50 and 60-gun vessels, on the stocks, into ships of a higher rate. About the same time he invented a new series of naval evolutions, signals, and orders of battle. His merits were well understood by the government, who rewarded him with a pension, and considerable rank in the service. He was now sent to Brett for the purpose of instructing the naval officers in his newly invented evolutions, &c. He met with an opposition, which is not uncommon in endeavouring to change old established customs. Of his opponents, two of the most distinguished were put under arrest and broke, though he did his utmost to prevent the punishment being carried to that extremity. He afterwards served under Vauban at the siege of Namur, from thence he repaired to St. Malo after the battle of La Hogue, to save the relics of the French fleet which had taken shelter there. Having constructed a vessel of 54 guns upon his own plan, Renau put to sea with the view of intercepting two rich English East Indiamen, one of which he captured after a desperate engagement. Among the booty were some packets of diamonds, which he thought of too great value to be claimed by himself, though the naval customs would have justified him in it, and he carried them to the king, who accepted the prize, and remunerated the captor with an annuity. When Philip V. succeeded to the crown of Spain, he sent to his grandfather, Lewis XIV., to request that he might have Renau to direct his engineers in fortifying his most important towns. He found means to render the crown of Spain the most important services, and was, in 1704, employed in the siege of Gibraltar, which, it has been assumed by the French biographer, was about to surrender, when it was relieved by the English fleet. To the disgrace of the court of Spain, whose interests he had effectually promoted, and in whose cause he had expended his own property, he was suffered to return to France with a single pistole in his pocket, though his Catholic majesty had given him the title of lieutenant-general of the armies of Spain. The high reputation which Renau had acquired as an engineer, caused the grand-master of Malta to request that he might be sent to that island on an alarm of an invasion, which was readily granted. Soon after this Lewis XIV. died, and the duke of Orleans succeeded to the regency, who appointed Renau to be counsellor of the marine council, and grand-croix of St. Louis. He died of a dropsy in 1719, and his death

was, like that of La Trappe, in ardent aspirations after another life: "What a difference," he exclaimed, "from one moment to the following! I am going to pass in an instant from the thickest darkness to perfect light." He had been twenty years an honorary member of the Academy of Sciences, and was among the first after that class was instituted.

RENAUDOT, EUSEBIUS, a learned writer on the ecclesiastical history and antiquities of the Eastern church, was born at Paris in 1646. He was educated at the Jesuits' college, and entered the congregation of the oratory when he was about 19 years of age, though he had no intention of entering into holy orders, or to the taking any ecclesiastical degree. He was particularly attached to the study of the oriental languages, in the knowledge of which he far excelled almost all his contemporaries; and he applied with success to the study of so many other tongues, that he was sufficiently master of seventeen different languages, to be able to speak the greater number of them with facility. He became well known at court, where his genius, his talents, and his politeness, made him much esteemed and admired. Here he was noticed by M. Colbert, who was desirous of establishing printing-presses for the oriental languages at Paris, and consulted Renaudot upon the subject, as a person who might ably contribute to render such an establishment useful to the state as well as the church. To engage his assistance, he promised him the reversion of the post of keeper of the king's library; but the minister died before the place became vacant. He received a similar promise from the archbishop of Rheims, and was again disappointed. He was, however, employed by the king in various confidential concerns of great importance relating to the affairs of Rome, England, Spain, &c. So much was his time occupied by these engagements, that he almost entirely discontinued his favourite studies. In the year 1689 he was received into the French Academy, and in 1692 into the Academy of Inscriptions and Belles Lettres. He found a patron in the cardinal de Noailles, archbishop of Paris, whom he accompanied to Rome in the year 1700, and into the conclave which elected Clement XI. to the papal dignity. While he remained in that city, the collections of the Vatican furnished him with new matter relating to the oriental churches, and revived an intention, which he had long before encouraged, of preparing for publication some pieces which serve to illustrate their history and opinions. In this design he was assisted by the new pope, who persuaded him to remain in Rome several months after the departure of cardinal de Noailles. His holiness would gladly have conferred upon him some valuable benefices, but he refused to accept of any thing beyond a small priory. The abbé Renaudot afterwards went to Florence, where he met with most flattering reception from the grand duke, who assigned him apartments in his own palace, loaded him with presents, and on his departure directed that he should be conveyed on board one of his own vessels to Marseilles. At Florence, likewise, he was made a member of the Academy de la Crusca. Soon after his return from France, he was roused by an attack upon father Nicole's "*Perpetuity of the Faith of the Catholic Church respecting the Eucharist*;" and in 1708 he published "*A Defence of the Perpetuity of the Faith against the Calumnies, &c.*" He afterwards entered more fully into the subject which he defended, and displayed all his erudition and ingenuity in endeavouring to shew the conformity between the doctrine of the Greeks, and all the oriental Christians, with that of the Latin church. What he wrote upon the subject extended to two vols. 4to. which were published in 1711 and 1713; by way of

of supplement to father Nicole's work. During the regency of the duke of Orleans he made frequent efforts to obtain his encouragement of the plan for establishing printing-presses for the oriental tongues, and was promised, but never obtained effectual support. The latter years of his life he spent in completing numerous very learned and important publications, among which may be mentioned, "Historia Patriarcharum Alexandrinorum Jacobitarum;" "Liturgiarum Orientalium Collectio," in 2 vols., accompanied with very learned dissertations: "Ancient Accounts of India and China, by two Mahometan Travellers in the 9th Century, translated from the Arabic." Renaudot died in the year 1720, at the age of 74 years, greatly regretted by the literati of that age, to whom he was a communicative and most agreeable companion, and lamented by the poor, to whose relief he had dedicated a large portion of his income. Moreri.

RENAY, or RONSE, in *Geography*, a town of France, in the department of the Jemappe, with a magnificent chateau; 7 miles S. of Oudenarde.

RENCHEN, a town of the duchy of Baden; 4 miles N.N.W. of Oberkirch.—Also, a river of Baden, which rises in the Ortenau, and runs into the Rhine, 10 miles N. of Oberkirch.

RENCOUNTER, formed from the French, *rencontre*, meeting, in the *Military Art*, the encounter of two little bodies or parties of forces.

In which sense, rencounter is used in opposition to a pitched battle.

RENCOUNTER, in single combats, is used by way of contradistinction to duel.

When two persons fall out, and fight on the spot, without having premeditated the combat, it is called a rencounter.

RENCOUNTRE, or RENCONTRE, in *Heraldry*, is applied to animals when they shew the head in front, with both eyes, &c. or when the face stands right forward, as if they came to meet the person before them.

Indeed, in deer, this is called *masacre*; and, in the leopard, it is the natural situation. He bears fable, in rencountre, a golden fleece.

RENDE, in *Geography*, a town of Naples, in Calabria Citra; 5 miles N.N.W. of Cosenza.

RENDER, in *Law*, a term used in levying a fine. A fine with render, is that by which something is rendered back again by the cognizee to the cognizor.

The lawyers also say, there are certain things in a manor, which lie in *prender*, i. e. which may be taken by the lord, or his officers, when they please, without the tenant's leave; and others which lie in *render*, that is, must be rendered or answered by the tenant, as rents, reliefs, heriots, and other services. See *PRENDER*.

Some service consists in seifance, some in render.

RENDERING, in *Building*. See *PARGETING*.

RENDERING, in *Sea Language*, is generally understood to be the effect of yielding or giving way, without resistance, to the efforts of some mechanical power. It is usually expressed of a complicated tackle, laniard or lashing, when the effect of the power applied is communicated with facility to all the parts, without being interrupted in its passage. It is therefore used in contradistinction to jamming.

RENDEZVOUS, or RENDEVOUS, a place appointed to meet in, at a certain day and hour.

The word is French, and is found so commodious, that most nations use it in its purity, for want of a word of equal import in their respective languages.

Thus, in a military sense, the rendezvous is the place ap-

pointed by the general, where all the troops that compose the army are to meet at the appointed time, in case of an alarm; and the regiments have their particular rendezvous, called their quarters of assembly.

In a naval sense, it denotes the port or place of destination, where the several ships of a fleet, or Squadron, are appointed to rejoin the whole, in case of a separation, occasioned by tempestuous weather, or other unforeseen accident.

RENDEZVOUS Bay, in *Geography*, a bay on the S. coast of Antigua, W. of Falmouth harbour.

RENDEZVOUS, *Island of*, an island, or rock, in the southern Indian ocean, discovered in 1773 by M. de Kerguelen, near the N. coast of Kerguelen's land, and called by captain Cook "Bligh's Night-cap."

RENDEZVOUS Key, a small island in the bay of Honduras, near the coast of Mexico. N. lat. 16° 59'. W. long. 88° 40'.

RENDS, in a *Ship*, are the same as the seams between her planks.

RENDSBORG, in *Geography*, a town of Germany, in the duchy of Holstein, seated on a canal which communicates with the Baltic, on the borders of Sleswick, supposed to be one of the strongest towns in the Danish dominions, and generally well garrisoned. The number of inhabitants is about 3600; 15 miles W. of Kiel. N. lat. 54° 22'. E. 9° 52'.

RENE', a town of France, in the department of the Sarthe; 15 miles N. of Le Mans.

RENEALMIA, in *Botany*, a new genus of Mr. Brown's, has lately received that name from him, in just commemoration of Paul Renealmus, or Renaulme, a physician at Blois, who published, in 1611, a thin quarto volume at Paris, entitled *Specimen Historiæ Plantarum*, with expressive, but stiff, and not neatly finished, engravings in copper, in which each plant is distinguished by an appropriate Greek name, mostly of the author's invention. Mr. Brown observes, that this author was the first who paid attention to the differences in the number, situation, and proportion of the stamens. Linnæus, in his own copy of the work, has expressed a well-founded surprize, at its being never quoted by the Bauhins. Plumier was the author of the first *Renealmia*, now sunk in the Linnæan *Tillandsia*. Linnæus, or his son, dedicated a monandrous genus, in the *Supplementum Plantarum*, to the memory of this meritorious botanist; but it proved not distinct from a more generally-received genus, of the same date, *Alpinia*. We with the present *Renealmia* may be found sufficiently different from *Sisyrinchium*, to which its species were originally referred by its learned author.—Brown Prodr. Nov. Holl. v. 1. addend. (*Sisyrinchium*; ibid. 304.)—Class and order, *Monadelphia Triandria*. Nat. Ord. *Enfate*, Linn. *Irideæ*, Juss. Brown.

Ess. Ch. Calyx none. Petals six, regular; three inner ones largest, contracted at the base. Style one. Stigmas three, thread-snaped, involute, acute. Capsule inferior, obovate, of three cells. Seeds angular.

The species are herbaceous, smooth, inhabitants of woods. Roots fibrous, sometimes tuberous. Leaves grassy, lax, ribbed. Stem roundish, sometimes divided. Flowers in alternate umbellate bunches, with short permanent sheaths. Corolla regular, white, spreading, soon falling off; the outer petals generally greenish at the back; the inner often furnished with claws. Filaments either combined below, or distinct; their upper part spreading. Capsule membranous. Seeds in two rows, black.

1. *R. paniculata*. Panicked Renealmia. Brown n. 1.—Stem panicked. Leaves ribbed; roughish at the edge. Outer petals

petals linear-lanceolate; inner scarcely twice as large, obovate-oblong. Filaments united half way up.—Gathered by Mr. Brown, near Port Jackson, New South Wales. The leaves are all from ten to eighteen inches long, and for the most part rough-edged.

2. *R. grandiflora*. Large-flowered Renealmia. Brown, under the former.—Stem panicled. Leaves ribbed; roughish at the edge. Inner petals four times as large as the outer. Filaments united half way up.—Gathered by the Rt. Hon. Sir Joseph Banks, in New Zealand. Akin to the former, but differing in the proportion of its inner petals, which are four or five times the size of the outer.

3. *R. pulchella*. Elegant Small Renealmia. Brown n. 2.—Stem nearly simple. Leaves with smooth edges. Outer petals oval-oblong; inner obovate, with short claws. Filaments distinct.—Gathered by Mr. Brown near Port Jackson. The leaves are only three or four inches long.

RENE'E DE FRANCE, in *Biography*, duchess of Ferrara, born at Blois in 1510, was daughter of Lewis XII. and Anne of Brittany. She was affianced, when very young, to Charles of Austria, afterwards emperor, and some years after was sought in marriage by Henry VIII. of England, but neither of these matches took place, and Francis I. gave her to Hercules II. of Este, duke of Ferrara. This princess is celebrated for her talents: she had a great capacity, and an insatiable thirst for knowledge, and her studies were not limited to history, the languages, and mathematics, but embraced various other topics, especially astrology and theology. The religious controversies of the time greatly interested her, and she became zealously attached to the tenets of the reformers; her court at Ferrara became the refuge of all who were suspected of heresy; and her conduct gave so much offence to the court of France, that Henry II. sent a doctor to the duke with the following instructions: "If the duchess persist in her errors, she must be separated from all conversation: her children must be taken from her, and all her domestics who are suspected of heresy, and who are to be prosecuted; with regard to the princess herself, the king refers to the prudence of her husband to proceed against her as he shall judge proper, avoiding, nevertheless, what might occasion too much scandal." After the death of the duke, in the year 1559, this princess returned to France, and resided at her castle of Montargis. In the religious wars the duke of Guise summoned her to deliver up some partisans who had taken shelter with her, she replied, "I will never deliver up those who look to me for protection; and if you attack the castle, I will be the first to appear in the breach, to see if you will have the audacity to kill a king's daughter." She was, however, at length obliged, much against her will, to send away 460 persons, to whom she had afforded an asylum. She parted with them in tears, after providing for the expences of their journey. At the massacre of St. Bartholomew she was the means of saving the lives of a great number of Protestants. Her four children were taken successively from her, and brought into France, to be educated in the principles of the Catholic church. She died at Montargis, in the year 1575. Moreri.

RENEGADO REEF, in *Geography*, a rocky shoal in the bay of Honduras, near the coast of Mexico. N. lat. 16° 16'. W. long. 88° 50'.

RENEGATE, RENEGADO, a person who has apostatized, or renounced the Christian faith, to embrace some other religion, particularly Mahometanism.

They are the renegadoes who prove the most barbarous to the Christians when they fall into their hands. The renegade is thus called, *quasi re-negat Christum*.—Hoveden men-

tions this in the year 1192, under the name of *renier*, from the French, *renier*, to deny again.

RENDLE, in *Geography*, a river of France, which runs into the Seine near Rouen.

RENDLING CURD, in *Rural Economy*, a term used provincially to signify the broken curd in cheese-making. See CHEESE and DAIRYING.

RENES, in *Anatomy*, the Latin name for the kidneys. See KIDNEY.

RENES Succenturiati, the two small bodies, of which one is placed above each kidney. The literal translation of the expression, *reserve kidneys*, seems to indicate a notion, entirely unwarranted by our knowledge of their organization and functions, that they might supply the place of the kidneys if they failed in their office. These bodies are also called capsule renales or atrabiliaræ, and glandulæ suprarenales. They are described in the article KIDNEY.

RENESBONA, in *Geography*, a river of America, which runs into lake Erie, N. lat. 41° 47'. W. long. 81° 55'.

RENETTE, in the *Manege*, is an instrument of polished steel, with which they found a prick in a horse's foot.

RENEWING of *Leafes and Lives*. See REVERSION, ANNUITY, POLITICAL Arithmetic, &c.

RENFORCER, Fr., in *Musick*, to reinforce, to pass from soft to loud, from loud to very loud, not all at once, but by degrees, swelling and augmenting the sound, whether a single note sustained, or a series of notes, till the order to reinforce the note or passage is fulfilled, and then return to the common degree of force.

RENFREW, in *Geography*, a royal borough-town in the county of Renfrew, Scotland, is situated near the south bank of the river Clyde, at the distance of six miles from Glasgow, and 49 miles W. by S. from Edinburgh. Though much inferior in magnitude and population to Paisley, it is the head-town, or capital of the county. This distinction it derives from its superior claims to antiquity, and from the circumstance of its being incorporated under a royal charter, originally granted by king Robert II., who had a palace in the immediate vicinity. In virtue of that deed it is governed by a provost, two bailies, and sixteen counsellors. In former times it sent one representative to the parliament of Scotland, and is now a contributory royal borough with Rutherglen in returning a member to the British legislature. About 200 years ago the Clyde passed close to the town, but the river afterwards deserted its ancient course, which has been converted into a canal communicating with its present channel. By this canal vessels of 200 tons burthen are enabled to reach the town in spring tides; but notwithstanding the advantage of that conveyance, the trade of Renfrew is very inconsiderable; owing, as Mr. Forsyth justly remarks, "to the pernicious effects of borough politics, in withdrawing men from industrious habits and pursuits." A small manufacture of thread, and some soap and candle works, on a confined scale, constitute the chief support of the town; but many of the lower orders are likewise employed in weaving for the manufacturers of Paisley and Glasgow. With respect to buildings, Renfrew consists chiefly of one principal street, about half a mile in length, with several lanes diverging from it. The houses are wholly constructed of stone, but are extremely irregular as to size, form, and position. The public buildings are the church, which is parochial, the town-hall, and a grammar-school. The last is under the patronage of the town-council, and is at present conducted with much ability. There is no regular market held here, but provisions of all kinds may always be obtained at a reasonable price. The
fairs

fairs take place on the third Tuesday in May and July, the 29th of September, and the first Friday in December. A general post-office is established at Renfrew. The revenue of the corporation exceeds 500*l. per annum*, arising from the rents of lands, customs, a salmon fishery on the Clyde, and the profits of a public ferry over that river. This ferry is perhaps the object most worthy of notice of any connected with the town. There is a ferry-house on each side of the river, the property of the corporation; and a ferry-boat constructed in so convenient a manner, that a carriage, with a pair of horses harnessed, can be ferried over and delivered by one man in five minutes. This is accomplished by fixing, on both banks of the river, a rope which runs upon rollers at each end of the boat, and being pulled by the boatman puts it in motion. Renfrew, as the shire town, is the place where all county meetings are assembled, and where the county quarter sessions of the peace are held.

Renfrew parish extends between three and four miles in every direction. The whole is level, inclosed, and in a high state of cultivation. The soil is a rich loam, and the climate is peculiarly healthy, though subject to occasional heavy rains. The burgh lands consist of about a hundred acres. This parish is intersected by the great road between Glasgow and Greenock. Ecclesiastically considered, it is within the presbytery of Paisley, and the synod of Glasgow and Ayr. According to the parliamentary returns of 1811, the number of its houses is estimated at 344, and its inhabitants amount to 2305. *Beauties of Scotland*, 8vo. vol. iii. Carlisle's *Topographical Dictionary of Scotland*, 4to. 1813.

RENFREWSHIRE, a county in the south-western division of the kingdom of Scotland, is bounded on the east by Lanarkshire, on the west, north, and north-east by the river Clyde, and on the south-west by the hills of Ayrshire. This county is of small extent, and of irregular shape; and contains, according to the parliamentary returns of 1811, 8409 houses, and a population of 92,596 persons. In general, and especially along the northern parts of it, the surface of the ground is level; but there are nevertheless several ridges of hills within its boundaries, some of which, upon the borders of Ayrshire, are of considerable elevation. The hills of Balagich and of Dunware rise to the height of 1000 feet above the level of the sea; and the isolated hill, called the Craig of Neillton, to 820. This last is covered with fine grass to its very summit. Those adjoining to Ayrshire, however, are bleak and barren, but command very fine views. On the south and west sides, the fertile vale of Cunningham, which seems at a distance to be wholly covered with wood, stretches itself to the shore of the Clyde; while on the north and north-east are beheld the level parts of Renfrew and the city of Glasgow, with the lofty Ben-Lomond towering above the clouds, in the back ground.

The rivers and lakes of this county are not of very considerable consequence in relation to themselves, but by the industry of the inhabitants on their banks, they have been rendered of great importance and utility to society. Unlike the romantic waters of Ayrshire, adorned with wood and exciting interest by the vestiges of ancient magnificence which they every where display, the streams of this district are made subservient to the purposes of human industry. If they descend from a height, it is not to add to the charms of the surrounding scenery, but to give motion to extensive machinery, inclosed within immense piles of building, where hundreds of mortals toil in the service of luxury, or form the materials which are to furnish clothing to distant nations. Here, if a stream spreads abroad its waters, it is not to embellish a park, but to afford convenience to a bleach-field, or to serve a reservoir for the mills in case of drought. In

proportion as Glasgow is approached, every thing assumes an aspect of activity, of enterprise, of arts, and of industry. The principal streams are the White-Cart, the Black-Cart, and the Grif, which fall into the Clyde below Inchinnan bridge. The White-Cart, which generally receives, by way of eminence, the Cart, runs in a direction from south-east to north-west, nearly parallel with the Clyde. It takes its rise in the moors of East Kilbride, Lanarkshire, and is particularly celebrated in ancient record for its fine large pearls. These, however, have long disappeared; but the river is become a source of more certain and beneficial wealth by its utility to the manufacturing interests of the county. Above Paisley, which stands upon its banks, it winds its way through a variety of small hills capable of cultivation to their summits; sometimes disappearing altogether, and again spreading its waters abroad into the plain. Below the town it is navigable for small vessels, and is thus beneficial to commerce and trade by facilitating the conveyance of goods. The Black-Cart rises out of Castle-Semple loch, in the parish of Lochwinnoch. From that beautiful lake it descends northward, and receives in its course the waters of the Grif. This last stream has its source in the elevated territory above Largs, which looks down upon the angle formed by the frith of Clyde. After its union with the Black-Cart, these conjoined rivers flow into the White-Cart at Inchinnan bridge. The lakes in the county, besides that of Castle-Semple above mentioned, are Queenside loch, in Lochwinnoch parish, two lochs in Neillton parish, and various other smaller ones, all of them appropriated to useful purposes.

The mineralogy of this county, though not so important as that of some others in Scotland, is nevertheless deserving of attention. In the parishes of Eaglesham and Kilbarchan, the mineral called the osmund stone is frequently found. This remarkable stone is of various colours, and when newly quarried, is so soft that it may be cut with a chisel; but afterwards becomes much harder. It breaks in all directions with unequal and harsh surfaces, readily absorbs water, and if recently heated, the absorption is attended with a hissing noise. Acids do not affect it, nor is it rent or melted by a strong heat. Hence it is much used for paving ovens, furnaces, &c. When burnt, it assumes a darkish colour, and loses three *per cent.* of its weight, but afterwards regains it by absorption. Some of it is considerably porous, and almost semivitrified, in which case, when struck, it emits a clear and strong sound. It is found in large masses in the form of rocks, having the intervening spaces filled with siliceous or calcareous spar, and occasionally with zeolite, steatites, and barytes. This last mentioned substance is found in abundance at Balagich hill in the parish of Eaglesham, where are likewise two very noted mineral springs. But the chief field of minerals in Renfrewshire is that in the vicinity of Paisley, which extends on the one side into the parish of Kilbarchan, and on the other towards Glasgow. That part of it which is most singular is the coal at Quarreltown, which is undoubtedly one of the most extraordinary masses of that mineral hitherto discovered in the British dominions. Its thickness, measured at right angles, is fifty feet; and it consists of five layers or strata in contact with each other. In consequence of its enormous depth, it is wrought in different floors, in the mode practised in great open quarries. It is difficult to form a just conception of the manner in which this singular mass of coal lies. In a field of fifteen acres, it is found to dip in various directions. At least, conceiving a nearly circular area of these contents, the coal, from the north, the east, and south quarters of that circle, dips pretty uniformly towards the centre. This,

RENFREWSHIRE.

however, is in some measure interrupted by several hitches, at one of which the mass of coal is suddenly thrown up about fifty feet, at another above thirty. These hitches interrupt not only the direction, but the degree of the dip. On one side of the northern hitch, it is about one foot in three; on the other side, only one in six. Some years ago, this bed of coal having taken fire, the pillars gave way and the ground sunk, leaving the surface in a very rugged state. The difficulties thus produced, however, have been surmounted, and this mineral treasure restored to all its utility. The other coal-mines in the county of Renfrew, are those of Hawkhead, Cathcart, and Kilbarchan. The first has been wrought above 200 years. In the same neighbourhood, lime is quarried in great quantities, also in Cathcart parish. Iron-stone accompanies all the coal strata, but is more particularly abundant along the shores of the Clyde.

On the agriculture of Renfrewshire, it will be unnecessary to offer many remarks. Almost every portion of the county is inclosed and cultivated, but grass lands are far more predominant than arable fields. This arises from the great demand which exists for the products of the dairy, the garden, and the fold, in consequence of the vicinity of trading and manufacturing towns, and the vast importation of grain which takes place from other parts of the country, or from abroad. Here the farmers are more sensible than to object to a free commerce in that article; because they do not envy the inhabitants of less populous districts, who find no better employment for their lands than that of scourging them by endless crops of grain. One would imagine that the practice in this district alone ought to decide the principle of the corn laws. Here, free importation, so far from injuring the farmer, augments the value of the soil in every respect, simply by increasing the ratio of population.

The lands here differ according to their vicinity to the Clyde, or in the lower part of the county, according to their proximity to the waters of the Cart. In the parishes of East-Wood and the abbey of Paisley, the lands are beautifully interspersed with small rising hills, although the soil is generally of a thin clay. Here the farmers keep one half of their grounds in grass, which they consider as the most important crop. In the upper district of the county, which comprehends the parishes of Mearns, Eaglesham, Neillston, Lochwinnoch, Kilbarchan, Erskine, and Kilmaccolm, the lands are peculiarly adapted for pasturing sheep, but none of them are so stocked, excepting some inclosures about gentlemen's seats, and a few parks in Neillston parish. The parish of Mearns is perhaps unequalled in Scotland for numerous small hills. The farmers here make large quantities of butter. The cows are small, of a brown and white colour, and are chiefly of the Ayrshire breed. Twelve of them afford, during the summer months, about sixty English gallons of milk daily. Towards the northern part of the county, in Kilmaccolm parish, the enclosures are generally formed of stones piled up to the height of four feet. The rotation of crops is three successive crops of oats, and six years of pasturage. Farm servants are usually unmarried, and live in the farmers' houses. The horses are of the best kind, and draw, in a single horse cart, from 17 cwt. to a ton. Farms throughout the whole county are on a small scale; few of them exceed seventy acres.

Renfrewshire contains one borough-town, Renfrew, and three large manufacturing and commercial towns; viz. Paisley, Greenock, and Port-Glasgow, all of which are noticed under their respective names. Here are likewise several populous and thriving villages, such as Pollockshaws, Bridge of Johnston, and Lochwinnoch, which are chiefly inhabited by weavers, who derive employment from

the manufactories of Glasgow and Paisley. The principal manufactured products are thread, silk-gauze, and different kinds of cotton goods.

Various remains of antiquity are still visible in this county. At Paisley was a celebrated abbey for monks of the order of Clugni, the ruins of which are much admired. Here is also an old chapel, in the early pointed style, which is noted as the burial place of Margery Bruce, and several of the earls of Abercorn. In the parish of Kilbarchan, near Castle-Semple, is one of those monstrous masses of whinstone, believed to be a druidical altar. It is twelve feet in height, and sixty-seven feet in circumference; and is known by the name of Clochodrigstone, a corruption of the Gaelic, Cloch-a-Drugh, the Druid's stone. It is composed of the same sort of whinstone of which the neighbouring hills are formed, and has probably been hewn from an elevated rock to the eastward, on which is a farm-house, called also Clochodrig; but by what mechanism it was conveyed cannot, in the present application of the mechanical arts, be easily determined. It rests upon a narrow base; but the lower part of it has been covered with stones gathered from the land. At some distance are several large grey stones, supposed to have been part of a sacred circle surrounding the altar. The parish of Cathcart is noted for being the scene of the battle of Langside, the last contested by the unfortunate queen Mary, to regain her authority. The place where the action was fought is an eminence rising rapidly on the north and west sides, and descending very gradually on the south and west sides. On the summit is an elliptical intrenchment, commonly called queen Mary's camp; but which is undoubtedly of much higher antiquity, and probably of Roman origin. On a hill, opposite to Langside, is the old castle of Cathcart, near which queen Mary stood during the battle, and witnessed the discomfiture of her friends, and the annihilation of her hopes. On the other side of this range of hills is another ancient castle, now in ruins, which belonged to the ancestors of the great reformer Knox; and at a short distance from it, on an elevated rock, may be seen one of those green artificial hills, usually called moats. It is of a square form, the sides facing the four cardinal points; the westward rests on the precipitous edge of the steep rock; and the remaining sides are defended by a deep trench, cut out of the solid stone. Each side of this mount measures sixty feet in length at the base, and nineteen at the summit; and is twenty-one feet high. The top appears to have been a hollow square, surrounded by a parapet, with an entrance on the eastern side. No fewer than five other artificial mounts can be seen from the one described; also a Roman encampment near Paisley, distant about five miles. On the top of Barhill are the remains of a rude encampment, which occupies the summit of a precipice, formed of a perpendicular rock of a basaltic appearance, which defends it on the north; and on the south it has a parapet of loose stones. The tradition in the neighbourhood is, that it was an encampment of the celebrated Sir William Wallace. The pinnacle of rock is shewn where they say Wallace sat while he enticed the English forces into a bog at the bottom of the rock, where they were all destroyed; but no historian confirms this statement. In an island of Castle-Semple loch is still to be seen the Pail or Peel, an old castle, to which the lairds of Semple were accustomed to retreat in times of unusual danger. In the lake, canoes hollowed out of single trees, like those of the Indians, have been occasionally discovered. Lower down the country the ruins of the castle of Newark chiefly claim attention. It stands on the eastern point of the bay, on which the town and harbour of Port-Glasgow is situated.

litated. When entire it consisted of a square court, with a tower at one angle, which is by far more ancient than any other portion of the building. When, or by whom it was erected, is unknown: this castle was long the property of the Dennistouns of that ilk, and afterwards came into the possession of the family of Maxwell. In this county is a variety of objects bearing the name of the renowned and patriotic Wallace, who was a native of the village of Elderslie, in the neighbourhood of the town of Paisley. See WALLACE.

The only other objects of antiquarian interest we shall mention, are four communion cups, still preserved in Kilmacolm parish, and which were used by John Knox in administering the sacrament of our Lord's supper. They appear to have been originally candlesticks; and it was perhaps only from the necessity of the times that they were converted to this pious purpose. They are of the purest silver; and, whether from the association of ideas, or their actual fashion, have a very antique and venerable appearance. Beauties of Scotland, vol. iii. 8vo. 1806.

RENGAH, a town of Sweden, in West Bothnia; 30 miles N.N.W. of Umea.

RENGO, a town of Sweden, in the province of Tavastland; 8 miles S.S.W. of Tavasthus.

RENI, GUIDO, in *Biography*, the principal painter of the Caracci school, was born at Bologna in 1574. At an early age he became the disciple of Denis Calvart, a Fleming of great reputation, but afterwards studied under the Caracci, preferring the style of Ludovico to that of Annibal, because there appeared more of grandeur and of grace in his compositions than in those of the others.

When he left the Caracci, he went to Rome; and with a mind intent upon forming a style of art for himself, studied the works of Raphael, with which he seemed enraptured; but the vigour and force with which the recent works of Caravaggio were conducted attracted him, and for a while he attempted to follow it. Happily he was diverted from it by an observation of Annibal Caracci; viz. that the best mode of rivalling the renown of Caravaggio might perhaps arise from a different mode of art, by contrasting his confined and lamp-like effects with a broader and more ample light; and for his vulgar forms, and obscure outline, substituting clearness in the parts and forms, built upon the pure models of antiquity. This remark, made in spleen by Caracci, operated powerfully on the mind of his skilful pupil, and induced him to try its truth. He immediately devoted himself to the study of what was graceful and agreeable in form, colour, and effect; and his success is testified by numberless beautiful productions, of which we possess many in England; and France is still more rich in them.

His composition is not, however, so free from affectation as the nature of the subjects he chose demanded; the very attempt to make them graceful, too frequently militated against its object, and he substituted the grace of the theatre for that of nature. In his female heads and proportions, his model was the antique: and the character and features of the daughter of Niobe is discernible in most of them. He dressed them with becoming elegance, and executed the different parts with great freedom and truth of pencil; not unfrequently, however, in a tone of colour too light, or too leaden for flesh; with a greenish hue, which rather characterises the hand of death, or the coldness of marble, than the glowing warmth of life, and the flexible softness of nature.

His disposition of draperies was elegant; judiciously applied to the filling up of voids in the grouping of limbs,

or figures, and was wrought with the greatest freedom; yet finished with almost minute attention to the foldings. These he arranged in a grand style, but they not unfrequently exhibit the study which he bestowed upon them; and appear to arise rather from the necessities of art, than the actions of the figures. The execution of his pictures is of the most free and agreeable kind; manifesting a perfect understanding of nature; the touch being light, full, and delicate; and though they are finished very highly, yet there remains no appearance of labour. In expression, he sometimes attained the greatest perfection; as in the head of our Saviour in the Louvre, and of which the president West has a very fine duplicate: but, in general, it was rather the grace and artifice of the theatre which guided him; and his figures appear to act more than to feel. Such was the respect paid to his abilities, that he was crowned with honour and riches; but it is lamentable to add, that one vice, in which he indulged after he had passed the meridian of life, viz. gaming, robbed him of both, and reduced him to poverty and disgrace; from which he was not able to free himself during the remainder of his life, which continued till he had attained the age of 67.

In the gallery of the Louvre there are between 30 and 40 of the works of Guido, large and small, and in his various manners; and as he there comes in immediate competition with his masters, connoisseurs have an excellent opportunity of judging of his comparative merit. We have also a great many of his easel pictures in England, but they are scattered about in various collections.

RENI, in *Geography*, a town of European Turkey, in Bessarabia, on the Danube; 40 miles W. of Ismail. N. lat. 45° 23'. E. long. 28° 44'.

RENIFORME FOLIUM, in *Botany*, a kidney-shaped leaf. See LEAF.

RENITENCY, RENITENTIA, or *Renifus*, among *Philosophers*, that force in solid bodies, by which they resist the impulse of other bodies; or re-act as much as they are acted on.

RENKY, in *Rural Economy*, a term provincially signifying tall or high, when applied to animals, &c.

RENNEBAUK, in *Geography*, a river of America, in the province of Maine, which runs into the Atlantic, N. lat. 43° 20'. W. long. 70° 27'.

RENNEBO, a town of Norway, in the province of Drontheim; 36 miles S. of Drontheim.

RENNEL'S SOUND, a bay of the North Pacific ocean, on the W. coast of Queen Charlotte's island. N. lat. 53° 28'. W. long. 133°.

RENNERSDORF, a town of Silesia, in the principality of Neisse; 8 miles E. of Neisse.

RENNES, a city of France, and chief city of the department of the Ille and Vilaine; and, before the revolution, the see of a bishop, and capital of Bretagne; situated on the Vilaine, by which it is divided into two parts. It is large and populous, containing eight parish churches, besides the cathedral and several convents. The four parts which it comprehends are denominated the north-east, south-east, south-west, and north-west. The first contains 5950 inhabitants, and its canton 13,147, on a territory of 142½ kilometres, in 7 communes; the second contains 5253 inhabitants, and its canton 12,064, on a territory of 97½ kilometres, in 4 communes; the third contains 3081 inhabitants, and its canton 12,254, on a territory of 142½ kilometres, in 9 communes; and the fourth part contains 11,620 inhabitants, and its canton 14,332, on a territory of 37½ kilometres, in 3 communes. N. lat. 48° 7'. W. long. 1° 36'.

RENNET,

RENNET, is *Rural Economy*, a term applied to the coagululum for making cheese. It is prepared from the bag, maw, or stomach, of the young calf, by a sort of salt pickle. It is of vast advantage in the art of cheese-making to have good sweet rennet, the particular mode of managing which may be seen under the heads **CHEESE**, **DAIRY**, and **DAIRYING**.

The preparation is formed in different modes, in different cheese districts, in the different parts of the kingdom; but mostly either in the manner of a solution, or that of a dry skin. As there is, however, much variation in the quality or strength of the different skins, it is probably the best method to reduce them into the state of a solution; as, by that means, the necessary quantity, in every case, may be the best ascertained.

In some places, it is found the most certain practice to prepare the whole of the dried maw skins, which are required for a season, at one time, by pickling and steeping them in different separate quantities of pure spring water and salt, in an open vessel, or vessels, mixing the different infusions together, and then passing them through a fine linen sieve, afterwards adding rather more salt to the whole than can be retained in the state of solution, as shewn by the appearance of some at the bottom of the vessel. The extraneous scummy matter, that comes to the surface, is continually to be removed as it rises, and fresh portions of salt occasionally supplied, as they may be wanted. In this state it is ready for use, about four ounces being sufficient for a large cheese.

In other parts, the maw skins are simply well salted, and steeped in salt pickle for some length of time; then well dried, by being spread out by means of small pieces of sticks; in which state they are made use of, by cutting pieces from the top and bottom parts of them, about the size of a half-crown for a middling-sized cheese, as those parts are in general the strongest.

And the following method of preparing rennet is practised in the northern parts of the island, and described as the most approved method in the Report on Agriculture for Argyleshire. Take the maw skin of a calf, which has fed entirely upon milk: after it is cold, wash it gently in water, fill it nearly with salt, and place it on a layer of salt in the bottom of an earthen mug. One or two more, with salt between, and a good deal above them, may be put in the same mug, and kept in a cool place, with a slate on the top, for six or eight months, or till cheese-making time next year. The skins are then taken out, and the brine allowed to drain from them; after which they are distended on small hoops or splinters put cross-wise within them, till they dry. Put the skins then in an open vessel, with three pints of pure spring water for each skin. Let them stand twenty-four hours; after which take them out, and infuse them other twenty-four hours in other water, but not more than a third of the former quantity. Mix these two infusions together, pass them through a fine linen sieve, and give them salt till the water is more than saturated, and some remain undissolved at the bottom. Rather less than a gill will serve for thirty-eight pounds of cheese. It is remarked, that, instead of two infusions, some use only one, giving four English pints to the skin, and direct the water to be first boiled, and mixed with salt into brine that will swim an egg, and then to let the heat go off till it is lukewarm, before the skin is put in twenty-four hours to steep.

It was formerly the practice to mix different kinds of aromatic herbs with the rennet; but the custom is much laid aside at present. The manner of doing it is this:

when the maw skin is well prepared, two quarts of soft pure water should be mixed with salt, in which should be put sweet briar, rose-leaves, and flowers, cinnamon, mace, cloves, and, in short, almost every sort of spice and aromatic that can be procured. Boil them gently till the liquor is reduced to three pints, taking care it be not smoked. Strain it clear from the skins, and, when milk-warm, pour it into the maw; a lemon may then be sliced into it, and remain a day or two, after which it should be strained, and put in a bottle well corked, and it will keep good for a year or more. A small quantity will turn the milk, and give the cheese a pleasing flavour.

RENNO, in *Geography*, a town of the island of Corfica; 3 miles N.E. of Vico.

RENO, a river of Italy, which rises a little to the N. of Pistoia, and runs into the Po, 4 miles above Ferrara.

RENO, a department of Italy, so named from the above-mentioned river. It consists of part of the Bolognese, and contains 199,300 inhabitants, who elect 15 deputies. The capital is Bologna.

RENOGRUND, a small island on the E. side of the gulf of Bothnia. N. lat. $63^{\circ} 59'$. E. long. $23^{\circ} 3'$.

RENOVATOR, in *Horology*, is a watch that has the property of *renewing* the power of its main-spring, or of winding itself up, by periodic jerks that it receives from the human body in motion. Recordon of Charing-Cross, London, took out a patent for this contrivance some years ago, which is more ingenious than useful; for, while it professes to keep the watch going, without the usual winding up, so long as the watch is worn in the pocket, it foregoes the more useful property of the fusee, and renders the maintaining power very unequal at different times of the day. And should the watch remain suspended, or laid down in a state of rest, for more than 24 hours, it will cease to perform; so that instead of being a watch that will go without winding, it requires to be wound many hundred times in the day, by small successive quantities, before it will continue to perform throughout the night. We have been favoured by the inventor with a copy of so much of the specification as will suffice to give our readers an idea of the mechanism, and of its mode of action; both which we have examined, and found corresponding with the specification. Others have varied the construction; but the original, we conceive, will be deemed sufficient for us to particularize, which we will do by a reference to *figs. 1, 2, and 3, in Plate XLIII. of Horology*, which are copied from the inventor's drawing.

Exact Copy of the Specification, No 1.—"Letter H represents a weight of silver, or other metal, which is in equilibrium in the position it is viewed, being sustained so by a spiral spring fixed to its arbor, as described by *fig. 3*. In wearing the watch, or by any external motion that lifts the watch up, it loses its state of rest; and by its vis-inertiæ (matter) overcoming the strength of the spring, it yields to the laws of gravity, and falls upon the lower spring, marked *ee*. When the watch, by the motion of the body, descends, the spring *ee*, and the aforesaid spiral spring, are left at liberty to exert themselves, and return the weight upwards, till it touches the other spring *ee*; and thus, by the motion of the body, is this weight alternately thrown up and down, which turning the ratchet-wheel, marked C in *fig. 2*, which is fixed on the arbor of the weight just below the spiral spring, gathers a few teeth every motion in the wheel P, and being prevented from returning by the click M, carries forward the wheel with a pinion of 10, marked E, which turns the wheel B; which having a pinion of 12 at G, takes into and turns a wheel under the barrel A, which is fixed on the barrel arbor, and by that means is the spring wound up.

The upper part of the barrel arbor, marked *b*, has a tooth, which gains a tooth in the wheel, *a*, every revolution; and that brings the pin *c* nearer to the centre, which, when it arrives in a certain position, raises the piece *K* (*fig. 1.*), of which the centre, *B*, (not seen in the figure) is conical, in order that when the said pin *c* comes near it, it raises it with ease, and forces it into the holes, marked *N, N, N*, in the weight marked *H* (*fig. 1.*), which effectually stops its motion, and prevents the ill consequence of over-winding.

L is a cock that carries the pivot of the barrel's axis.

I is a cock that carries the pivot of the wheel *H*.

A is the barrel which carries a wheel, that catches the pinion *D*, which carries the minute-hand."

The patent was obtained in July 1780; and part 2d of the specification contains drawings, and a plan for applying the same principle to the fusee; but we do not understand that it has yet been made to answer.

RENRIETH, in *Geography*, a town of Germany, in the county of Henneberg; 3 miles S. of Schleusingen.

RENS, **RENSE**, or *Rees*, a town of France, in the department of the Rhine and Moselle; near which, in the Rhine, is a remarkable monument of antiquity, called the "Königstuhl," or "Thronus regalis," consisting of a round vault, built of free-stone, and resting upon nine stone pillars, one of which stands in the middle. This vault is 80 feet in circumference, furnished above with seven seats, agreeable to the number of electors at that town. The ascent to it is by stairs of stone, consisting of 28 steps, and it has two strong doors. On this regal chair the electors formerly held previous consultations for some time, concerning the election of a king and emperor; and when that election could not be performed at Francfort, it was done at this place; and here were also transacted the notification and elevation of the elected personage, and also the consultations of the electors concerning the weighty matters of the empire, as well as a solemn confirmation of their privileges on the part of the emperors. Here also was established, in the year 1338, the electoral league. Maximilian I. is thought to be the last emperor who was brought hither; 5 miles S. of Coblenz. N. lat. 50° 18'. E. long. 7° 37'.

RENSSEN, a lake of Prussia, in the palatinate of Culm; 10 miles N.N.E. of Culm.

RENSSELAER, a county of New York, bounded N. by Washington county, S. by Columbia, E. by part of the states of Massachusetts and Vermont, and W. by Hudson river. It contains eight townships, *viz.* Troy, Greenbush, Schodack, Stephentown, Petersburg, Hofick, Pittstown, and Schactekoke. It contains 36,309 inhabitants.

RENSSELAERVILLE, or **RENSSELAERWICK**, a township of Albany county, New York, bounded S. by Columbia county, and W. by Hudson river. In this township, opposite to the city of Albany, is a medicinal spring, combining most of the valuable properties of the celebrated waters of Saratoga.

RENT, **REDITUS**, in *Law*, a profit, such as a sum of money, or other consideration, issuing yearly out of lands or tenements, alienated on that condition.

The word rent, or render, *reditus*, signifies a compensation, or return; it being in the nature of an acknowledgment given for the possession of some corporeal inheritance. Co. Litt. 144.

It is thus called from the corrupt Latin, *rendita*, for *reddita*, of *redditus*; because, as Fleta tells us, *retroiti, et quontannis reddit*.

The original of rents is to be sought for in the constitution of the ancient feuds, which were of a military nature,

and in the hands of military persons: however, the feudatories, being under frequent incapacities of cultivating and manuring their own lands, soon found it necessary to commit part of them to inferior tenants, obliging them to such returns in service, corn, cattle, or money, as might enable the chief feudatories to attend their military duties without distraction; which returns, or *reditus*, were the original of rents.

Under the pure feudal system, this *reditus*, return, or rent, consisted, in chivalry, principally of military services; in villenage, of the most slavish offices; and in socage, it usually consisted of money, though it may still consist of services, or of any other certain profit.

Rent is regularly due and payable upon the land from whence it issues, if no particular place is mentioned in the reservation (Co. Litt. 201.); but, in case of the king, the payment must be either to his officers at the exchequer, or to his receiver in the country. (4 Rep. 73.) And strictly the rent is demandable, and payable before the time of sunset of the day in which it is reserved; though some have thought it not absolutely due till midnight. 1 Saund. 287. Prec. Chanc. 555. Salk. 578.

The usual remedy for non-payment of rent is distress; however, by the common law, distresses were incident to every *rent-service*, and by particular reservation to *rent-charges* also, but not to *rent-fee*, till the statute 4 Geo. II. c. 28. extended the same remedy to all rents alike. Moreover, by this statute it is enacted, that every landlord, who hath, by his lease, a right of re-entry in case of non-payment of rent, when half a year's rent is due, and no sufficient distress is to be had, may serve a declaration in ejectment on his tenant, or fix the same upon some notorious part of the premises, which shall be valid, without any formal re-entry or previous demand of rent. And a recovery in such ejectment shall be final and conclusive, both in law and equity, unless the rent, and all costs, be paid or tendered within six calendar months afterwards. Other remedies are action of debt, an assize of mort d'ancestor or novel disseisin, the writ de consuetudinibus et servitiis, which compels a specific payment of the rent, the writ of cessavit, and the writ of right for disclaimer.

For an account of the rental of England and Wales, see *POLITICAL Economy*.

The lawyers ordinarily reckon three sorts of rents, *viz.* *rent-service*, *rent-charge*, and *rent-fee*.

RENT-SERVICE, is where a man holds lands of his lord by fealty, and certain rent; or by fealty-service, and certain rent; or that which a man, making a lease of lands to another for term of years, reserveth to be yearly paid for them.

Rent-service is so called, because it hath some corporal service incident to it, as at the least fealty, or the feudal oath of fidelity. (Co. Litt. 142.) For, if a tenant holds his land by fealty, and 10s. rent; or by the service of ploughing the lord's land, and 5s. rent: these pecuniary rents, being connected with personal service, are therefore called rent-service. And for these, in case they be behind, or in arrear, at the day appointed, the lord may distress of common right, without reserving any special power of distress; provided he hath in himself the reversion, or future estate of the lands and tenements, after the lease or particular estate of the lessee or grantor is expired. Litt. § 215.

RENT-CHARGE, is where a man makes over his estate to another by deed indented, either in fee, or fee-tail, or for term of life; yet reserves to himself, by the same indenture, a sum of money yearly to be paid to him, with a clause of distress.

distress for non-payment: so called, because, in this manner, the land is charged with distress for the payment of it. Co. Litt. 143.

RENT-SEC, or *Dry-Rent*, or *Barren-Rent*, is that which a man, making over his estate by a deed indented, reserveth yearly to be paid to him, without any clause of distress mentioned in the indenture. There are also other species of rents, which are reducible to these three.

RENTS of Affize, are the certain established rents of the freeholders, and ancient copyholders of a manor; thus called, because affized and certain, in opposition to *reditus mobiles*.

Those of the freeholders are often called *chief rents*, *reditus capitales*, and both sorts are indifferently denominated *quit rents*, because by them the tenant goes quit and free of all other services. When these payments were reserved in silver or white money, they were anciently called *white rents*, or *blanch-farms*, *reditus albi*; in contradistinction to rents, reserved in work, grain, or base money, which were called *reditus nigra*, or *black-mail*. 2 Inst. 19.

RENT, Fee-farm, is a rent-charge issuing out of an estate in fee; of at least one-fourth of the value of the lands at the time of its reservation. (Co. Litt. 143.) *Rack-rent* is only a rent of the full value of the tenement, or near it. For a grant of lands, reserving so considerable a rent, is indeed only letting lands to farm in fee-simple, instead of the usual method for life, or years.

These are the general divisions of rent; but the difference between them (in respect to the remedy for recovering them) is now totally abolished; and all persons may have the like remedy by distress for rents-sec, rents of affize, and chief-rents, as in case of rents reserved upon lease. Stat. 4 Geo. II. c. 28.

RENTS Resolute, are reckoned among the fee-farm rents to be sold by the stat. 22 Car. II., being such rents or tenths as were anciently payable to the crown from the lands of abbeyes and other religious houses; which lands, upon the dissolution of abbeyes, being demised to others, the said rents were still reserved, and made payable to the crown.

RENTS, assart, chauntry, chief, gold, paschal, rack, quit, and white. See the several adjectives.

RENT, in *Agriculture*, the price paid for lands as farms by the tenants of the proprietors. The rents of lands are so extremely various, according to the nature of the soil, situation, markets, the state of the fences, buildings, and other conveniences, the ease of obtaining manures, and many other circumstances, as to be almost incapable of having any general specific prices affixed to them. They were formerly, especially in the northern parts of the island, paid in produce and personal services; but at present, according to Mr. Donaldson, over the greatest part of the island, they are paid in money, and at two periods or terms in the year. In England, Michaelmas and Lady-day are the customary terms of payment; the first payment commences six months after entry to the possession of the farm. But that in Scotland, the ordinary terms are Martinmas and Whitsuntide, or Whitsuntide and Martinmas, the tenant being allowed twelve months' credit of the first half of the rent in the one case, and in the other eighteen. And he observes, that this difference in the terms of the payment of rents is material in the purchase of landed property, being in general nearly one year's purchase in favour of England. And it is farther stated, that it was the custom of former times, in various parts of Great Britain, for the tenants to pay what was called *fore-hand* rents, that is, paying the half, and in some cases, the whole year's rent immediately

on entering to the farm, and before any benefit was derived from the possession of it. This practice is, however, now generally disused, although still kept up in some parts of Staffordshire and Perthshire, in some degree. And we believe that it still prevails in some places in Ireland. It is likewise added, that letting lands for a term of years at the former rent, but making the farmer pay a considerable sum in ready money by way of fine, was also a very common custom; but is now chiefly confined to the crown and church lands in England. This mode was evidently attended with bad consequences. By draining the tenant of all, or greatest part of his ready money, he was prevented from improving his farm. Leases of lands are considered in law as heritable property; therefore, in the event of the demise of the tenant, soon after having completed a transaction of this nature, his eldest son succeeded to the lease, and the widow and other children were of course, in many instances, reduced to poverty; all that was left to them being their proportion of the stock on this farm, and often thereby the heir was rendered incapable of keeping possession of the farm. In a word, in nine cases out of ten, it was robbing the tenant of the well-earned reward of his industry, during the existence of the former lease, and depriving him of the means of turning his new acquisition to the best account; without giving any solid advantage in return for it.

It is remarked also, that along the greatest part of the east coast of Scotland, which is the principal corn country in the kingdom, a considerable proportion of the rent of almost every farm is paid in grain and oatmeal. These articles being less fluctuating in their value than money, this appears the most equitable mode in which the rents of corn farms can be paid. It may indeed affect the farmer's interest when any sudden and unexpected rise takes place in the price of grain; but if a judgment can be given from experience, it will be found this very seldom happens. On the contrary, for these last twenty years, with only two exceptions, 1783 and 1795, the price of grain, owing to the operation of the corn laws, has been extremely moderate, while every other production of a farm has been doubled in value, and in many cases tripled. Since these periods, the price of this article has, however, risen, and continued high. The public are often essentially benefited by so great a proportion of the rents being paid in this way. Many of the proprietors have granaries erected on their estates, where, in times of plenty, they store the grain and meal which they receive from their tenants. And every person, who is in any degree acquainted with the agricultural exports and imports which take place between some districts in Scotland and others, must, he thinks, know that the supplies afforded on many occasions from these store-houses have been the means of preventing scarcity, and an unreasonable advance in the price of these articles in the large manufacturing towns and other populous places. In East Lothian, according to the agricultural report of that district, it has been suggested by some proprietors, that one half of the rent should only be paid in money, the other in kind; and assigned as a reason, that the profit or loss arising from any material, as the rise or fall in the price of grain, would, in that way, be equally divided between the landlord and tenant. This is a mode probably founded on equity and justice. And it is further stated, by the first writer, that in the most northern parts of Scotland, the rents are, to a certain extent, paid in personal services. The tenants are bound to plough and harrow a certain portion of the landlord's farm, to reap, carry home, thresh, dress, and mill a certain quantity of the crop. They are also bound to pay poultry, eggs, butter, cheese, sheep, swine, linen

linen yarn, fish, &c. ; in a word, they are more the slaves of the landlord than their own masters.

These are shameful feudal practices, which the proprietors of such lands should remove as soon as possible, as without it their interests must suffer greatly from the lands remaining without improvement. Besides, it is a species of bondage highly disgraceful to civilized society. The able author of the Agricultural Report of the county of Argyle in Scotland, thinks that all services, whether paid to the master or to any under him, should be entirely abolished; and all rents formed into one sum of money, including public burdens, such as ministers' stipends, schoolmasters' salary, road money, &c. Thus, says he, the tenant would have always a clear view of the amount of his rent, and save time and trouble, and perhaps expence, by having to settle with one only instead of many. His time is precious, and should never be thrown away without necessity.

In regard to the parliamentary and parochial taxes, they may be said to be paid, the first writer says, by the tenants over the greatest part of both kingdoms; and many leases contain a clause, he observes, binding the tenants to pay, not only all the taxes that are imposed, but also all that may be imposed. But, he thinks, that it appears absurd that the proprietors, whose interest it is to attend to the increase or decrease of all such taxes as more immediately concern their property, should devolve the payment of those taxes on their tenants. They must know, that whoever pays them in the first instance, to them the lands are of less value, in consequence of such taxes having been imposed. They ought also, he thinks, to consider that their influence might be the means of keeping the most extravagant of them, such as the tithes and poor's rates, within more reasonable bounds, than it is to be expected the utmost exertions of the tenants can be able to effect. And that, further, proprietors could ascertain the value of their property with more minute exactness, were they, on the one hand, to receive from their tenants the full rents which their lands are worth, and, on the other, pay all taxes to which they are subjected. The interest of agriculture, and the ease and comfort of the farmers, would at the same time, he thinks, be essentially promoted, were they relieved from these teasing exactions and compositions with which they are so frequently molested, particularly in this part of the kingdom.

And he suggests, in respect to the general price of renting lands, that when it is considered how many circumstances operate in determining the rent of land, and how much these frequently vary in the same parish or lordship, it will be found impossible to form any correct idea in regard to the rents payable by the acre for the various kinds of soil over the whole island. Any conjecture that may be formed (for the subject admits, he says, no more) must be vague and incorrect. It is supposed, that the remarkable change that has taken place in the situation of the kingdom and the manners of the people, by the abolition of the feudal system, the increase of commerce, manufactures, and agricultural improvements, with the immense additional quantity of paper-money introduced within these few years into circulation, have had the effect of enhancing both the value and rent of lands. While these flourish, and paper-money supports its nominal value, lands in property or lease must necessarily, he thinks, continue to advance. But that, should any cross accident interrupt the former, or depress the value affixed to the latter, the recent great advance in the rent of lands, in various parts of the island, would render such calamities more universal in their effects, and of course of more serious consequence to the country.

The rent of land is kept up by a great variety of local

causes, as the particular nature of the farms, their extents, the goodness of the roads and markets, the convenience of canals and other forts of water carriage, and many other circumstances of a similar nature. In dairy and grass districts, as well as some others, rents are kept up by the particular modes of occupation, in many instances. Many little advantages are connected with the former; while the latter has not any heavy expences to contend with. Small farms are constantly higher rented than those of the larger kind. Convenient carriage and large markets are always favourable to rents. Local convenience has invariably great influence in raising the rent of land. In short, it has been suggested by an able writer, that every sort of improvement in agriculture, as well as manufactures, has a tendency to advance the rent of land; and that, if, to the practical excellence of the former, improvements in the latter should be added, with a more extended commerce, rents may be raised to an extraordinary degree. While the contrary of these matters is calculated to reduce the quantity of wealth, and, of course, to lower the rent of land; consequently rent rises and falls with the prosperity or declining state of the agriculture, the manufactures, and the commerce of the country, the former of which is only to be preserved by peace.

But though the rents of land have been greatly increased within these few late years, it is probable that they must feel the effects of the vast load of taxation and other charges which bear so hard upon agriculture at present.

But the ascertaining of the rents of lands in the different districts of the kingdom is a point of considerable importance both in a political and agricultural view, as by such means the produce of them may be better and more certainly calculated.

Mr. Smith, in his valuable Agricultural Survey of Argyleshire, states, that the quality of the soil is there extremely different; so that such valuations as have been lately made, differ, sometimes on the same farm, from 2s. to 15s. the acre of arable ground. The pasture, too, being partly green hill, but mostly heath, differs no less in its quality than the arable land. Some of it is valued below 4d. and some above 4s. the acre. In the neighbourhood of Campbellton, a few spots of arable land let from 2l. to 3l. the acre. But this price may be said to be put, not altogether upon the land, but partly upon the accommodation. But what proportion the rent of a farm should bear to its produce, depends so much on soil, climate, situation, and other circumstances, that no general rule can, he thinks, be laid down on the subject. In regard to arable lands more particularly, it is a common, though perhaps not a just remark, that one-third of the produce should go for rent, one-third for expence and management, and one-third for the farmer's profit, interest, &c.

But Mr. Middleton remarks, that the method practised by some gentlemen, of estimating the produce of land by trebling the rent, is very fallacious: three times the rent is not by any means equal to the value of the produce of the land under the best system of husbandry now in use; though under the old exploded course of fallow, wheat, oats, in the scanty produce of common fields, and when taxes and the expences of living were at one-half of the present amount, it was not very distant from the truth. But under the more improved courses of husbandry on land, at and under twenty shillings an acre, the produce is now, he thinks, more generally worth from five to seven times the rent.

In the North Riding of Yorkshire, as stated in the report of that district, the average rent of farms of pretty good soil is from 15s. to 21s. *per* acre; in which there may be land rated

RENT.

at from 5*s.* to 35*s.* *per* acre, so that the average value of a farm will vary according to its proportion of good and bad land. Some farms of the latter kind may be let as low as 5*s.* *per* acre, and some let cheaper at 30*s.*; so great is the inequality of the soil, that nothing accurate on this head can be stated. Near large towns, land for convenience in small parcels, and in the aggregate to no great amount, is let at 3*l.* or 4*l.* *per* acre.

But in the western district of that county, as about Skipton and Settle, the lands were found to let as high as 40*s.* and 50*s.* the acre; while from the best information in the corn part of the county at the same time, 20*s.* and 30*s.* were considered as a high rent, and in many places it was still much lower.

In Shropshire, the rents of lands, where the roads are bad, and the grounds little improved, are from 8*s.* to 12*s.* the statute acre, and in more favourable districts and situations, from 15*s.* to 20*s.* the farm together. But near towns, the price is much higher, as from 2*l.* to 6*l.* the acre.

And in Norfolk, according to Mr. Young, in the light sand district, as marked in the Survey, the average price of letting is 6*s.* the acre; the various loams at 16*s.*; the better sands at 12*s.*; the rich loams 26*s.* and the marsh land clays 28*s.* In Suffolk the several soils are stated to be rented as below, the whole county included, sheep-walk, waste commons, &c. which are very large deductions from the rate of the cultivated lands:

	<i>s.</i>	<i>d.</i>
Strong, wet loam, <i>per</i> acre - - -	13	0
Rich loam - - - - -	14	0
Sea district of sand - - - - -	10	0
Western district of ditto - - - -	5	0
Fens - - - - -	2	6

But in all the districts, with the exception of the fen, there are tracts that are let at 20*s.* to 25*s.* and even higher, especially meadows.

In the county of Essex, the average rent of good landed farms may be stated at about 20*s.* or 25*s.* the acre. They have lately increased very much in some places.

In Sussex, good land is rented at from 20*s.* to 30*s.* the acre, but there is a great deal let at much lower rents.

Land has risen much of late years in many parts of the country.

In the county of Oxford, the rent of land is very various. The red land lets on the average at 30*s.*, the miscellaneous loams at 25*s.*; the stone-brash at 20*s.*; and the Chiltern at 16*s.* the acre. There are, however, large portions of land let at still lower rents in different parts.

In Cheshire, the land averages full 30*s.* the acre in rent as farms; and in Lancashire, the rent of land is equally as high, if not higher.

In the very south-western district of Cornwall, the rents of land fluctuate very greatly, as from 5*s.* to 50*s.* the acre in farms properly so named. The circumstances affecting rents here, besides the quality of the soil, and the aspect or situation, are the vicinity to sea sand, and to market towns. There are instances of land letting very high in particular situations, as at 13*l.* the acre about Penzance. And in the same parishes the rents of land sometimes vary from 8*l.* to 5*s.*; nay, even on the same farm, not exceeding 150 acres, some parts are worth 50*s.*, and others not 5*s.* the acre.

The neighbourhood of towns and large markets, as well as of extensive manufactories, has, in all cases, a tendency to raise the rent of land, whether as farms or otherwise, in every part of the kingdom.

In all parts of Scotland, even in the Highlands, the rise of rents has been gradual and progressive for many years, and in some places they have been more than doubled within these last twenty-five or thirty years.

It has been stated by Mr. Collingworth, of Daventry, in the fourth volume of Communications to the Board of Agriculture, that in respect to the principle of increasing rents, where liberty is given to break up old grass or pasture lands that are under lease, that he has known, within this five years past, a double rent given for leave to plough up an old pasture for cropping for three years; and that consequently it appears to him that a statement of the expenses and profits upon arable and pasture lands should be severally made out, to ascertain by how much the balance of profit of the one exceeds that of the other. He therefore states them, upon a probable calculation, in the following manner:

TABLE of Expenses.

	1.	2.	3.	4.	5.	6.	7.
	Pease.	Wheat.	Pease.	Wheat.	Beans.	Sp. Wheat.	Total.
	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>
Rent and taxes - - -	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	10 10 0
Seed - - - - -	0 18 0	0 16 0	0 18 0	0 16 0	0 10 0	0 14 0	4 12 0
Ploughing - - - - -	0 12 0	0 12 0	0 12 0	0 12 0	0 12 0	1 4 0	4 4 0
Harrowing - - - - -	0 2 6	0 2 6	0 2 0	0 2 6	0 2 6	0 2 6	0 14 6
Manure and carting - -	0 0 0	0 0 0	2 10 0	0 0 0	2 10 0	0 0 0	5 0 0
Frightening birds - -	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 12 0
Weeding and hoeing - -	0 1 6	0 1 6	0 1 6	1 6 0	0 3 6	0 1 6	0 11 0
Reaping and mowing - -	0 6 0	0 10 6	0 6 0	0 10 0	0 6 0	0 10 6	2 9 6
Cocking and raking - -	0 2 0	0 0 0	0 2 0	0 0 0	0 1 0	0 0 0	0 5 0
Carrying and stacking -	0 4 0	0 4 0	0 4 0	0 4 0	0 2 0	0 4 0	1 2 0
Thatching - - - - -	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 6 0
Threshing and winnowing	0 6 0	0 9 0	0 6 0	0 9 0	0 7 6	0 9 0	2 6 6
Carrying to market - -	0 4 0	0 4 0	0 4 0	0 4 0	0 4 0	0 4 0	1 4 0
Contingencies - - - -	0 4 0	0 4 0	0 4 0	0 4 0	0 4 0	0 4 0	1 4 0
	4 18 0	5 1 6	7 7 6	5 1 6	7 0 6	5 11 6	35 0 6

Produce.

RENT.

Produce.

	£	s.	d.
1. Pease, three quarters, at 48s.	7	4	0
2. Lammas wheat, three quarters and a half, at 52s.	9	2	0
3. Pease, three quarters, at 48s.	7	4	0
4. Lammas wheat, three quarters and a half, at 52s.	9	2	0
5. Beans and turnips; five quarters of beans, at 30s.; turnips, 30s.	9	0	0
6. Spring wheat, three quarters, at 48s.	7	4	0
Straw	5	4	0
	54	0	0

Tillage produce	54	0	0
Ditto expences	35	0	6

6) 18 19 6 (= 3*l.* 3*s.* 3*d.* profit *per* acre for the farmer.

Grazing Expences.

	£	s.	d.
Rent and taxes <i>per</i> acre	1	15	0
Labour ditto	0	10	0
	2	5	0

Grazing Profit.

	£	s.	d.
A bullock and a half to three acres, at 5 <i>l.</i> <i>per</i> head	7	10	0
Three sheep upon ditto, at 25 <i>s.</i> <i>per</i> head	3	15	0
	11	5	0

Grazing produce of three acres	11	5	0
Ditto expences of ditto	6	15	0

3) 4 10 0 (= 1*l.* 10*s.* 0*d.* profit *per* acre to the grazier.

	£	s.	d.
Then say, grazing profit <i>per</i> acre	1	10	0
To which add for grafs feeds	1	0	0
The additional rent to make up the sum as <i>per contra</i> , will be	0	13	3
	3	3	3

By this means the rent that can be afforded to be given may be ascertained with tolerable correctness in many instances of farming. See GRASS Land.

The author of the Argyleshire Agricultural Survey, after remarking that there is very little arable land in that county but which is capable of higher cultivation, besides the great quantity of waste ground that may be improved in almost every farm, says, that the land is therefore capable of being made to yield a much higher rent when better cultivated; though not a great deal of it, as is generally thought, can bear much more, in the present stage of improvement, than what is laid on already, unless it be under a different management, which in sheep lands might be by the introduction of better woolled breeds, and in arable lands by adopting a better system of husbandry.

It is conceived, that the idea of high rents being a spur to improvement and exertion, is a common, and, to a certain extent, a just maxim. No doubt there may be some who, if they had the land for nothing, would be ruined by their indolence. But the more common case is, that when a tenant sees that all his exertions will not do, he becomes dispirited and desperate, and allows himself to be carried along by the stream which he cannot stem. The land

suffers, the tenant fails, the farm gets a bad name, and the rent must be lowered. Thus the landlord, as well as the tenant, suffers, by raising the rent higher or faster than the improvement of the land will bear. But he adds, that a substantial tenant is generally cautious of engaging to pay a rent that is exorbitant. He sees the success of those who invest their money in other branches of business; and he follows their example, if he has not the prospect of a farm's yielding him full interest for his money, and an adequate return for his diligence and labour. Whereas he who has leaft to lose, is often the most forward to offer, and the landlord is often tempted to accept the offer, without considering that a capital is necessary for paying the rent, and improving the land. Instances of ruin to the tenant, and loss to the landlord, from too high rents, are not unfrequent, especially on some of the smaller estates. Most of the farmers toil hard, live poorly; and for one who has a trifle for his pains, perhaps two give their pains for nothing. Many who have old leases obtained before the late rise in land, and in its produce, took place, are very well, as are also many of those who have sheep stocks; as their possessions are managed with less expence, and the value of some of them was not well known till they were tried under the sheep system. But even bad

bargains are become good by the late rise on every article of produce; and most of those who have leases are at present at their ease.

It is concluded that the occupiers of land, whether in pasturage or tillage, ought certainly to be able, like labourers or tradesmen, to live by their occupation, and to support their families by their daily care and labour. The interest of money invested in their stock, with the proper allowance for tear, wear, and risk, they should be able to save as a provision for their families, and for old age; as the money so invested would give this return, if laid out on interest, without any trouble whatever. It cannot be considered as any part of the produce of the ground; and therefore no part of it ought, in equity, to enter into the payment of the rent; and yet not one in ten, perhaps, is able to save it; nor do they commonly advert that so much ought to be saved in justice. They are generally satisfied if they can keep their stock undiminished; so that the business, in general, returns much less to those engaged in it than almost any other. A happy predilection in favour of the occupation in which they were brought up, is, he thinks, what induces so many to follow it. Perhaps it may be also said, that there is implanted in the human mind, for wise purposes, a certain innate disposition, or instinct, which leads it to delight in rural occupations.

These remarks should be well attended to by the proprietors of farms, as their advantages, as well as that of their tenants, may be greatly promoted by such means.

In regard to the receiving of rents where they are of different kinds, as for cottages, tithes, in the form of compositions, chief rents, quit rents, and some other sorts, besides those of the farm kind, they require some attention and method, such as the fixing of distinct times in the same, or different days, for the reception of each, when on a large scale, so that the exact times of attendance for each may be known to those who have any thing to settle. So far as farm rents are concerned, the fixing of proper periods for receiving them is of great importance, though the matter has hitherto been little attended to, there being often no fixed time known to the holders, until signified by the precept of the receiver. And that is, in many cases, liable to alteration. This is very inconvenient to the farmers in many instances, as they must either sell their corn and live-stock to great disadvantage, many times, before it was necessary, and have large sums of money lying uselessly by them, or meet the receiver, perhaps, with only part of the rent. The propriety and necessity of having certain exact times for receiving rents are therefore evident, and, of course, the most suitable times for these are to be ascertained, as whatever enables the holders of land to turn their produce to the most advantage, increases the prosperity of the farms, and ultimately benefits the proprietor.

In this country it is said, by the author of the work on Landed Property, farm rents mostly become due at Lady-day and Michaelmas. But the proper times of paying them depend on the marketable produce of the land, and the season of the year at which it goes, and can be best sold in the markets. The holders of farms should never be forced to improper regulations in these respects, or be suffered to withhold the payment of their rents when they have obtained the money for their produce.

Upon corn farms, which are numerous in most parts of this country, Michaelmas is the most improper time in the whole year to call upon tenants for their rents. It is at the close or height of harvest, as the situation may be, when their pockets are drained by extra expensive labour, and when the grain cannot be threshed out to replenish them; also when

much of the off-going live-stock is not ready for the market.

In the county of Norfolk the above writer paid great attention to this matter, and found that there, the latter end of February, or beginning of the succeeding month, was the most proper season for Michaelmas farm rents to be paid; and the month of June for those of Lady-day. And, by correct examinations, those most proper in other places may be found, keeping the above principles constantly in view. Farmers should never be obliged to do any thing improper in the disposal of their articles at unfavourable seasons or markets, or to raise money in any improper ways; nor be led into speculations with money while it lies idly by them.

The best seasons having been ascertained, the exact periods are to be fixed on, from the particular nature of the farms, the customs of the districts in respect to fairs and the dealers in different sorts of produce, which may generally be readily managed without much difficulty.

RENT Accounts, such as are kept on estates, whether of farms, cottages, chief rents, or any other sorts of annual payments, by the managers. They should be clear and comprehensive, containing every thing of importance about them, as their different circumstances may direct.

The management of the farms, in rent accounts, whether yearly or half yearly, must be the same as in the receiving rentals, as they appear on the general map; and as they naturally lie on the face of the estate, according to the ideas of the writer of the work on Landed Property. See *MAP of Estates*.

The parishes, or manors, lying wholly or partially within the estate, are to be first geographically arranged, and then the farms on the same principle as they lie within the respective parishes. In this way it is constantly the same, and has the advantage of not being liable to be disturbed by changes of any sort, which affords much facility and convenience in all such accounts on many occasions.

RENT Charges, the fixed payments to which an estate or farm is subject to, such as chief rents, quit rents, annuities, endowments, schoolmasters' salaries, charitable donations, &c.

RENT Days, the particular days or times when the rents of estates or farms become due. They should, in all cases, be exactly and properly fixed as to season and other circumstances. See *RENT*.

RENT-Roll, a general statement of the gross annual income of an estate, or receivership, whether it arises from farms, woods, lands, quarries, cottages, or any other similar things; or from tithes, quit rents, or any other sort of rents, &c.

In forming rent-rolls, this sort of general view of income is best arranged, according to the writer of the work on Landed Property, in columns, as being the most plain and perspicuous; and for a schedule of farms, the following heads are proper. First, the numerals identifying the several farms in the general map. Secondly, the names of the farms. Thirdly, the contents or admeasurements of each. Fourthly, the names of the present holders. Fifthly, the amount of the existing rents. Sixthly, the amount of the outgoing, if any payable by the proprietor. And, seventhly, the expirations of the terms, if any. The farms should be arranged according to their situations.

In the receiving of rentals, they are the particulars. These are few where the rents are regularly paid, the farms under proper management, and the holders pay the taxes and repairs. But it may be necessary to see in the receiver, at one view, the name of the farm, and the name of the holder, as well as the amount of his half year's rent.

And

And where arrears are suffered, and, of course, accounts created, more particulars are necessary, such as the name of the farm and the tenant, his arrear at the last payment, his half year's rent, and any other charge that may be against him, as well as any allowance which is to be made to him, and the neat sum that is receivable—a blank being left for the sum received, and another for the arrear left. These things should be done in the manner of the best accountants, the arrangements being made in the same way as the rent-roll with an alphabetical index.

RENTA, in *Geography*, a lake of Albania, near Scutari.

RENTAL, a roll in which the rents of a manor are written and set down, and by which the lord's bailiff collects the same; it distinguishes the lands and tenements, and the names of the tenants, the several rents arising, and for what time, usually a year. See *RENT-Roll*.

RENTER WARDEN, an officer in most of the companies of London, whose business is to receive the rents or profits belonging to the company.

RENTERBACH, in *Geography*, a river of Saxony, which runs into the Elbe near Wittenberg.

RENTERIA, a town of Spain, in Guipuscoa; three miles S.E. of St. Sebastian.

RENTING, FINE-DRAWING, in the *Manufactories*, the sewing of two pieces of cloth, edge to edge, without doubling them; so as that the seam scarcely appears at all: hence it is called *fine-drawing*.

The word is formed from the French, *rentraire*, which signifies the same thing; and which Menage, after Salmasius, derives from the Latin, *retrahere*, of *re*, in, and *trahere*, by reason the seam is drawn out of sight, and covered.

Serges, &c. are to be sewed: cloths fine-drawn. The author of one of the *Lct. Edif. et Cur.*, speaking of the great dexterity of the fine-drawers in the East Indies, assures us, that if you tear a piece of fine muslin, and give it one of them to mend, it shall be impossible for you to discover the place where it is rejoined, even though you had made a mark to know it by.

The dexterity of our own fine-drawers, though inferior to that above-mentioned, is nevertheless such, as puts them in a condition to defraud the king, by sewing a head or slip of English cloth on a piece of Dutch, Spanish, or other foreign cloth; or a slip of foreign cloth on a piece of English, so as to pass the whole, as of a piece; and by that means avoid the duties, penalties, &c. The trick was first discovered in France by M. Savary, author of the *Diction. de Commerce*.

To *renter*, in *Tapestry*, is to work new warp into a piece of tapestry damaged, eaten by the rats, &c. and on this warp to restore the ancient pattern, or design. The warp is to be of woollen, not linen. Among the titles of the French tapestry-makers, is included that of *renterers*.

Fine-drawing is particularly used for a rent, or hole, happening in the dressing or preparing of a piece of cloth, artfully sewed up or mended with silk.

All fine-drawings are reputed defects or blemishes; and ought to be allowed for in the price of the piece. Hence, M. Savary establishes it as a rule, which is certainly founded on natural equity, that every manufacturer mark the fine-drawings of his cloth with a piece of packthread tied to the list; to direct the draper to the spot: and that the draper apprise the tailor, or other person to whom he sells it, of the same, that he may not come to damage in the cutting; there being instances of drapers condemned to take back their cloth, when cut to pieces, for omitting to mention the fine-drawings, and other flaws.

On this occasion, M. Savary extols the procedure of an

English merchant, who, sending a piece of cloth damaged in one spot, to his correspondent at Paris, put a piece of gold in the damaged place, to make up the damage. But as this example is perhaps the only one of its kind, that author recommends it to the merchant, or draper, to unfold all the pieces entirely, as they come to him; to discover the fine-drawings, and other flaws, in order to make the clothier accountable for them.

RENTERSHAUSEN, in *Geography*, a town of the duchy of Wurzburg; 7 miles E. of Lauringen.

RENTOWN, a town of Scotland, in Dumbartonshire, considerable for its manufactures; 5 miles W. of Dumbarton.

RENTRE'E, Fr. in *Music*, a return to the subject of a musical composition, after a pause, or some excursion or deviation from the theme; or in a fugue, an imitation of some particular passage or design.

RENTY, in *Geography*, a town of France, in the department of the fraits of Calais, on the Aa; 9 miles S.S.W. of St. Omer.

RENTZ, a town of the island of Rugen; 11 miles S.S.W. of Bergen.

RENUENTES, in *Anatomy*, a pair of muscles of the head, thus called as being antagonists to the annuents; and serving to throw the head backward, with an air of refusal.

From their situation they are also called *rectus capitis*, major et minor.

RENVERSE', Fr. in *Music*. With respect to intervals inverted, this term is opposed to direct. (See *DIRECT*.) With respect to chords, it is opposed to *fundamental*; which see.

RENVERSE', *inverted*, in *Heraldry*, is when any thing is set with the head downward, or contrary to its natural way of standing: thus, a chevron renversé is a chevron with the point downwards.

The same term they also use when a beast is laid on its back.

RENVERSED VOLTE. See *VOLTE*.

RENVERSEMENT, Fr. in *Music*, an inversion in the order of sounds which compose the chords, and in the parts which constitute the harmony: which is done by substituting, by octaves, treble notes for the base, and base notes for the treble. It is certain that every common chord has a fundamental and natural order pointed out by the harmonics of a single string, a great bell, or organ pipe. (See *HARMONICS*, and *RESONANCE*.) But the circumstances of the succession, taste, expression, selection of notes for melody, variety, approximation of the harmony, frequently oblige a composer to change this order, by inverting the chords, and consequently the disposition of the parts. As any three things may be arranged in six different ways, and four things in twenty-four ways, it seems at first as if a common chord was susceptible of six changes, and an accompanied discord of twenty-four; as the one is composed of three sounds, and the other of four; and that the inversion only consists in the transposition of octaves. But it must be remembered, that in harmony a change in the upper parts is not regarded as an inversion, provided the base or fundamental sound remains the lowest. Thus, these two orders of sounds, *Ceg*, or *Cge*, are not regarded as inversions of the harmony. And in the chord of the 7th no change in the upper parts constitutes an inversion.

As long as the fundamental sound is the lowest part, the order is direct. But when this order is changed, or the fundamental sound is given by transposition to one of the upper parts, the harmony is inverted. In whatever part a discord is prepared, it must be resolved by the same part;
a sharp

a sharp 7th must ascend, a flat 7th must descend; false relations must be avoided. This is the key to the chief mysteries of composition. Binding notes in syncopation in the treble and base must be differently treated: in the 9th the chord is direct; in the 2d it is inverted, the discord being in the base.

Upon the organ, and other keyed-instruments, inversions are necessarily made for the convenience of the hand, in giving different faces to the same chord. See FACE.

RENVERSING. See REVERSING.

RENUKA, or RENUCI, in *Mythology*. See RUNEKA.

RENUNCIATION, RENUNCIATIO, the act of renouncing, abdicating, or relinquishing any right, real or pretended.

Renunciations are sometimes *express*, as by contracts, &c.; sometimes *tacit*, as by contrary acts.

To renounce an inheritance, a community, &c. is to pass a solemn act before a notary, or public officer, by which a person declares he will not intermeddle in an inheritance, or profit in a company; but surrenders his part, and quits all pretensions.

RENOVI, Fr. in *Music*, a reference to a strain, or part of a strain that is to be repeated; either implied by dots in the spaces of the staff, or by an *§*. dotted, which is the initial of *segno*, Ital. a sign. See REPEAT.

RENWEZ, in *Geography*, a town of France, in the department of the Ardennes, and chief place of a canton, in the district of Mézières; 7 miles N.W. of Mézières. The place contains 1202, and the canton 6061 inhabitants, on a territory of 140 kilometres, in 16 communes.

REOLLE, LA, a town of France, and principal place of a district, in the department of the Gironde. N. lat. 44° 35'. E. long. 0° 2'.

REORDINATION, REORDINATIO, the act of conferring orders on one already ordained.

The ceremony of ordination impresses what the divines call an indelible character; and cannot, therefore, be repeated: yet is reordination practised in England, with regard to the dissenting ministers, who conform to the church; the bishops pretending that they alone have a right to confer holy orders, and that every priest or minister, who does not receive them at their hands, has no lawful or regular vocation.

This has formerly proved a great obstacle to the re-union of those ministers to the church of England; many of whom, otherwise disposed to conform, have scrupled to be re-ordained; inasmuch as re-ordination implies their former vocation to be null; that they had administered the sacraments without any right thereto; and that all their ministerial acts were invalid.

In the 11th century, the crime of simony having been very flagrant, many people fell into the error to believe, that the simoniacal bishops could not ordain validly, and those who had received orders at their hands should be re-ordained. The people of this opinion made a party of themselves, and were distinguished by the title of "Reordinantes."

REORTHE, LA, in *Geography*, a town of France, in the department of the Vendée; 13 miles W. of Châtaigneraie.

REPAIR a Statue, To, or other piece of sculpture, is to touch up a statue, &c. (cast in a mould) with a chisel, graver, or other instrument, to finish the places which have not come well off.

To REPAIR a Cast, figure, or the like, they clear off the barb, and what is redundant in the joints and projectures. See STATUE.

To REPAIR a Medal, is to retouch it; so as, from rusty and defaced as it was, to render it clean, neat, and perfect. In order to this, they take off the rust with a graver, touch up the letters, polish the ground, and raise and restore the figures which before were sometimes scarcely seen. When the figures are eroded or broken, they fit a piece of cement on the spot; and on this cut with a graver so dexterously, that the figures appear entire, and well kept; yet nothing spoils medals so much as repairing them. See MEDAL.

To REPAIR a Ship, is to amend any injuries, or supply any deficiencies, which a ship may have received by age, battle, tempestuous weather, &c. The repair is necessarily greater or smaller in proportion to the loss or damage the vessel has sustained. Accordingly a suitable number of the timbers, beams, or planks, or a sufficient part of either are removed, and new pieces fixed in their places. The whole is completed by *breaming*, *calking*, and *paying* the body with a new composition of itself.

REPAIRERS, artificers who chase figures and beautify sword-hilts, &c.

REPAIRING, in *Building*, &c. See REPARATION, and RESTAURATION.

The repairing of large walls, doors, ceilings, coverings, &c. belongs to the proprietor or landlord: the tenant is only charged with small repairs, as glass windows, locks, &c. by the French called *locative* repairs.

REPAIRS, in *Hunting*, are the haunts and places which the hare runs to.

REPAIRS of Farm Buildings, in *Rural Economy*, the necessary means of putting and keeping them in proper order. This properly belongs to different sorts of workmen, as masons, carpenters, &c. It is a bad practice to let buildings of this nature fall much into decay, as by such neglect a great deal of expence is frequently incurred that might otherwise have been avoided. See FARM-BUILDINGS.

REPANDUM FOLIUM, in *Botany*, a leaf whose outline is undulating, without the surface, or substance, being otherwise than even. See LEAF, where, for *nymphaeoides*, read *nymphaeoides*.

REPARANDIS PONTIBUS. See PONTIBUS.

REPARATION, REPARATIO, the act of repairing, re-establishing, retrieving, or mending a building, or other work, damaged, or gone to decay.

The enemy repaired the breach as soon as it was made. The establishment of turnpikes is for repairing of the roads. An ecclesiastical patron is by ancient custom obliged to repair the choir or chancel of a church, and the parishioners the nave.

REPARATIONE FACIENDA, in *Law*, is a writ which lies in divers cases, *e. gr.* where there are tenants in common, or joint tenants of a house, &c. which is fallen to decay, and the one being willing to repair it, the other two will not; in this case, the party willing shall have this writ against the other two.

REPARO, in *Geography*, a small island near the coast of Brasil. S. lat. 29° 23'.

REPART, in the *Manege*, is to put a horse on, or make him part a second time.

REPARTEE. See REPARTY.

REPARTITION, REPARTITIO, a dividing or sharing a thing a second time.

REPARTY, or REPARTEE, a ready, smart reply: especially in matters of wit, humour, or raillery.

The word in the original French, *repartie*, has the same signification.

Wicquefort observes, that there is a great difference between

between a free, sprightly repart, and an offensive *sarcasm*; which see.

REPAST, REPASTUM, a meal or refecton, taken at a stated hour.

In old law-books repast is particularly used for a meal's meat given to servile tenants, while at work for their lord.

The French call their meal *repast*; the Latins, *paslus*; the Italians and Spaniards, *paslo*.

In antiquity the repasts were frequently sacrifices; for which reason we find them often prepared by kings themselves.

REPEALING, in *Law*, the revoking or annulling of a statute, deed, or the like. See ABROGATION, REVOCATION, &c.

No act of parliament shall be repealed in the same session it was made in. A deed or will may be repealed for a part, and stand good for the rest.

Brook uses the word *repellence* in the same sense.

REPEAT, in *Music*, a character shewing that what was last played or sung must be repeated, or gone over again.

The repeat serves instead of writing the same thing twice over. There are two kinds of repeats; the *great* and the *small*.

The *great* repeat is only a double bar, dotted on each side; or two parallel lines drawn perpendicular across the staff; with dots on either hand. See its form under CHARACTERS of *Music*.

This mark shews, that the preceding strain is to be repeated; that is, if it be near the beginning of the piece, all hitherto sung or played is to be repeated; or, if towards the end of a piece, all from such another mark.

In gavots, we usually find the repeat at about the third part of a piece; in minuets, boreas, courants, &c. towards the end.

Some make this a rule, that if there be dots on each side the bar, they direct to a repetition both of the preceding and the following strain; if there be only dots on the side, then only the strain on that side is to be repeated.

The *small* repeat, is where only some of the last measures of a strain are to be repeated: this is denoted by a character set over the place where the repetition begins (see CHARACTERS, in *Music*), and continues to the end of the strain.

When the song ends with a repetition of the first strain, or part of it, instead of a repeat, they use the word *da capo*, *i. e.* from the beginning.

REPEATING CIRCLE, an instrument used in *Navigation*, *Astronomy*, and *Surveying*. This instrument derives its name from the property it has of giving the average of several repeated measures of an angle, made round the whole circle, so as to diminish the errors of division and of eccentricity; which is a very useful property, where the art of dividing is not brought to that perfection which it is in England. When the lunar method of determining the longitude, by the help of improved tables of the moon's motion, was proposed to be put in practice, Mayer offered a construction of the circle, which, by repeating the measure of a lunar distance, promised to increase the accuracy with which such distance could be measured; and after him, Borda went a step farther towards the attainment of the desired object, both whose contrivances we have described under our article CIRCLE. These instruments, like Hadley's octants, measured the angles by reflection, and were consequently used at sea; but the principle of repetition is not confined to reflecting instruments; and Borda constructed, or contrived the construction of, a repeating circle, which will measure either vertical or horizontal angles without reflection, with a degree of accuracy that has placed it high

in the estimation of the French, among whom accurate dividing is yet a desideratum. This instrument we have also described, and likewise Troughton's improvement on it, in the article already referred to.

But the repeating principle was extended by Joseph de Mendoza Rios in the reflecting circle, so as to measure both backwards and forwards, and to give *double* results by means of a moveable or *flying* circle, which we have likewise described under the article CIRCLE, together with our observations on the peculiarities of its construction. It remains, therefore, that we now describe a recent construction of a reflecting and repeating circle, contrived by professor Hafsler of Philadelphia, who is a native of Switzerland, and who has resided several months in London, for the purpose of collecting superior astronomical and surveying instruments, at the expence of the American government. The object of this ingenious foreigner was to unite the repeating principle of Borda, with the firm construction of Troughton's reflecting circle, so that his new instrument might be free from the objections of the repeating circles that preceded it, arising from shallow centre-work, and clamping after the contacts were made in an observation; and in the construction he has adopted, by the aid of Troughton, he has rendered his instrument free from these objections, and given it every advantage which its original contriver contemplated: we cannot, however, admit, that in practice it is superior in accuracy, and certainly not in simplicity, to Troughton's *reflecting circle*, which we have before described, as giving the average of six readings at two operations, in inverted positions, at the different sides of zero on the fixed circle. The union of Borda's and Troughton's constructions is thus effected by Hafsler; the circular border of Troughton's instrument is made moveable round the centre, like his three armed verniers, and is graduated like his, while a pair of opposite verniers move round the same centre, above the plane of the moveable or flying circle, having a clamping apparatus for slow motion at one of the two opposite verniers, so that the pair of verniers may be made to revolve with or without the graduated flying circle; another pair of verniers, similar to the former, and having also a clamping apparatus for slow motion, are made fast to the frame, and have the extreme ends of their connecting diametrical bar united by a graduated semicircle, that lies under the flying circle, and is hid thereby when the graduated face of the circle is uppermost; the use of this semicircle is, to receive a pair of sliding pieces of brass that act as stops to the indices, when they are properly placed at the rough angle, to the right and left of zero on the flying circle, by a previous operation; so that, when the bar of the verniers comes in contact with either of these stops, it is known, even in the dark, that the place where a contact is to be made is nearly ascertained, and the vernier-bar may be made fast, for the screw of slow motion to be brought into action to complete the contact. The principle on which the measurement is effected is this; the revolving verniers move forward from zero of the graduated circle, when the stops are previously set to the rough angle, till the index or vernier-bar touches the stop to the left, when the graduated face is uppermost, and is clamped to the fixed verniers; the clamping apparatus then fixes the verniers, and the tangent-screw completes the contact; the two revolving verniers might now give the angle, by two readings, but the repeating principle has not yet been introduced, and consequently no advantage is yet derived from this first observation, over a common circle with a double vernier; the fixed verniers are in the next place unclamped, but as they have no motion, the flying circle and revolving verniers are brought back to the right together, across the point zero, till

REPEATING CIRCLE.

till the vernier-bar touches the second stop, and during this motion, the revolving verniers have moved backwards just *double* the rough distance with the attached circle, that they did forwards before without it; consequently the fixed verniers will now read the same angle at the right of zero, that the revolving verniers did on the left, when the clamping is again made and the contact completed; but still this is only a second mode of reading a single measure of the angle, and nearly all that is yet gained in accuracy, is the extermination of the index error, and that of the dark glass, if used; these errors having been alternately positive and negative, if any existed. These two measures, separately read, are equivalent to Borda's *crossed* observation, as he calls it, because the motion of the vernier-bar *crosses* the point zero in his fixed circle: here it is presumed that the two objects, that include the angle, are equally luminous; but if not, it will be necessary to invert the face of the instrument before each second, fourth, sixth, &c. contact, and then the motions will all be forward, or from right to left, which otherwise would be alternate: the second reading, however, may be omitted; the revolving verniers, being unclamped, must be moved again to the first stop in the original position, where, the contact being complete, they will give a *double* measure if examined; but the readings are yet omitted: the fixed verniers are now unclamped, the instrument again inverted, and the contact completed, when these verniers, if examined, will also give double measures; and thus treble and quadruple measures must be had successively at both the revolving and fixed verniers, or even more, if the circle has not been passed over by each pair of verniers, before the readings are required to be examined, and then the average of all the measures by the fixed verniers, added to an average of all the measures by the revolving verniers, will afford the means of getting an average of the whole number of measures.

From this description of Hafsler's mode of applying the repeating principle, it will be obvious to the reader, that the diametrical bars of the two pair of verniers must not be contiguous to each other, when the glasses called the horizon-glass and index-glass are parallel; and accordingly we find, on examining an instrument of this construction, that these bars cross one another at right angles before the operations begin; but as there is but one zero in the circle, one pair of the verniers must necessarily begin at 90° , when the other pair begins at 0; consequently ninety degrees must be deducted from the sum of the measures of this pair before their average is taken: otherwise, if neither pair of the verniers begin at zero, the two numbers from which they respectively commence must both be deducted before the averages are taken, in which case it will be of no importance at what part of the flying circle the operations begin. Should the reader find any difficulty in comprehending this description of Hafsler's repeating circle, without a reference to a drawing, we recommend that he refer to our account of reflecting circles, described under the article *CIRCLE*, where he will find the account of the two separate instruments of which this forms an union; and at the same time will see how it differs from Mendoza's, which gives *double* results.

By way of illustrating the use of Hafsler's repeating circle, we will suppose that some known star is to the east or west of the moon, and that the longitude of the place of observation is required from an actual measurement of the distance of the said star from the moon's limb, when compared with its computed distance as given for a certain hour on the same evening at Greenwich, in the Nautical Almanac: we will suppose the glasses of the circle adjusted, and the small telescope screwed into its socket, and so adjusted both

for distinct vision, and comparative brightness of both objects, that the star can be brought to touch the moon's limb, and have a sensible contact; in the first place, hold the plane of the circle in such an inclined position that it may pass through both objects, and get the star into the field of view, while the revolving verniers are at zero, and the fixed ones clamped at 90° ; in the next place, move the revolving verniers with an equable motion, and let the eye follow the star, or rather the image of it, till it comes to the edge of the moon, which it may be made to approach by a proper motion of the body; then clamp the index there till the stop is put on the semicircle very nearly to touch the edge of the index, where it must remain; the second stop must also be put to the same division on the semicircle at the other side of its zero, provided this zero be co-incident with the zero of the circle; or, which is the same thing, the distance between the stops must be somewhat more than double the angle to be measured; the contact may now be completed by the tangent-screw; let the fixed verniers be unclamped, and the released circle and revolving verniers be made to recede together till the second stop gives them a check, there they must be clamped and the circle inverted, when the star will again be seen nearly in contact, which must now be made entirely so by the screw of slow motion; in the next place the moveable verniers, being first unclamped, must be carried again to the first stop and clamped, to make the contact as before, after the inversion of the circle has again taken place; and in this manner the revolving verniers must be moved to the first stop, and the verniers and circle together to the second stop, before each inversion and contact, till five, six, seven, or more alternate operations have been gone through, and the whole circle has been travelled over, which may always be known from the position of the stops. The exact times must be noted at the beginning and end of these operations, which by an expert observer will be gone through in a few minutes, and the mean time will be had of the moment corresponding to the mean of the repeated observations: at these times the assistants must also take each their two altitudes. Say now that the stops were required to be nearly at 40° at each side of zero of the semicircle, or that the distance between them was 80° , within a few minutes over, and that there were nine observations thus made with the revolving verniers, and eight with the fixed ones, which numbers suppose the first and last measures to be taken with the same pair of verniers, or with the same face of the circle uppermost; say also, that the final readings by this pair of verniers were respectively $1^\circ 10' 20''$, and $181^\circ 10' 0''$, or rather $361^\circ 10' 20''$, and $541^\circ 10' 0''$, because these verniers completed the entire circle; then if we diminish the latter reading by 180° , its distance before the other, we shall have $361^\circ 10' 0''$, and the average of the pair of opposite verniers will be $361^\circ 10' 10''$, which quantity divided by 9, the number of measures taken by them, will give a quotient of $40^\circ 7' 8''.9$ for the first average of the distance, resulting from the operation of the revolving verniers alone; again, let the final readings of the fixed verniers be respectively $50^\circ 57' 20''$ and $230^\circ 57' 30''$; but if we increase the first reading by 360° , we shall have $410^\circ 57' 20''$, which must be diminished by 90° , because it started from this number, and the remainder will be the correct reading, namely $320^\circ 57' 20''$; also $230^\circ 57' 30''$ increased by 360° is $590^\circ 57' 30''$, and this number diminished first by 90° , as before, and then by 180° , the distance by which it precedes its fellow-vernier, will be $320^\circ 57' 30''$, and consequently the average of the two final readings of the fixed verniers will be $320^\circ 57' 25''$, which sum divided by 8, the number of repeated

peated measures in the inverted position, will give a quotient of $40^{\circ} 7' 10''.6$ for the distance averaged by the fixed verniers; and lastly $\frac{40^{\circ} 7' 8''.9 + 40^{\circ} 7' 10''.6}{2} = 40^{\circ} 7'$

$9''.75$, the exact *apparent* distance, which may be converted into the *true* distance by any of the methods used for clearing it of the joint effect of *parallax* and *refraction*. See *LONGITUDE*, and *LUNAR Observations*.

REPEATING Mechanism, in *Horology*, is a mechanical contrivance that, when acted on by a pull or push, will make the striking part of a clock or watch repeat the hours and quarters of existing time, so that a person in the dark, or even in bed, may know within a quarter of an hour what it is o'clock, as well by night as by day. The first contriver of the repeating mechanism of a clock was Barlow, a London clock-maker, who in the year 1676 produced to the world his specimen of ingenuity, which astonished all the admirers of the mechanical arts, and excited in others a desire to vary the construction, with a view to the improvement of the original contrivance; and the consequence has been, that Quare, Tompion, and others in London, as well as after them Julien le Roy, Thiout, Collier, Larçay, Berthoud, &c. on the continent, have given to many different kinds of repetition, for both clocks and watches, that a particular description of each construction would require several plates, and a whole volume to give the details. Under our article *CLOCK* we have already explained at considerable length the particulars of the repeating mechanism of two several clocks, as it is constructed at this time, from which the reader will see how the acting parts may be varied in many ways to answer the same purpose; but in most of the modern contrivances the *rack* and the *snail* constitute the basis of the plan, and regulate the action of all the metallic parts employed. For the repeating mechanism of a watch, see our article *WATCH*.

REPELLENT MEDICINES, are those which prevent such an afflux of fluids to any part as would excite tumour or inflammation, or which tend to diminish such an afflux, when it is already produced. Medicines of this quality are principally refrigerants and astringents, especially the former. The most effectual repellent is cold; and those applications, therefore, which most effectually obstruct the heat, are the most efficacious repellents; and many of the drugs, which are applied in combination with cold liquids, are of little value; the cold menstruum, that is the water, being the principal agent in the curative process.

REPELLING POWER, *vis repellens*, in *Physics*, is a certain power or faculty residing in or exerted by the minute particles of natural bodies, by which, under certain circumstances, they mutually fly from each other.

This power is the reverse of the attractive power.

Sir Isaac Newton having established the attractive power of matter from observation and experiment, argues, that, as in algebra, where positive quantities cease, there negative ones commence; so in physics, where the attractive force ceases, there a repelling force must begin; and adds, that there is such a force, does likewise appear from observation.

As the repelling power seems to arise from the same principle as the attractive, only exercised under different circumstances, it is governed by the same laws: now the attractive, we find, is stronger in small bodies than in great ones, in proportion to the masses; therefore the repelling is so too. But the rays of light are of all others the most minute bodies we know of; therefore, of all others, their repelling force must be the greatest.

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Sir Isaac Newton computes, that the attractive force of the rays of light is above 1000000000000000 times as strong as the force of gravity on the surface of the earth: hence arises that inconceivable velocity with which light (if it consist of real particles) must move, to reach from the sun to our earth in seven minutes. For the rays emitted from the body of the sun by the vibrating motion of its parts are no sooner got without the sphere of attraction of the sun than they come within the action of the repelling power.

The elasticity or springiness of bodies, or that property by which, after having their figure altered by an external force, they return to their former figure, follows from the repelling power. See *REPULSION*.

REPENTANCE, in *Theology*, is a change of sentiments followed by a change of conduct: or repentance denotes such a conviction of the evil and danger of a sinful course, as is sufficient to produce shame and sorrow in the review of it, and effectual resolutions of amendment. This definition expresses the sense of the two words *μεταμελεια* and *μετάνοια*, which are commonly used by the evangelical writers to signify repentance.

REPENTIGNY, in *Geography*, a town of Canada, on the river St. Laurence. N. lat. $45^{\circ} 48'$. W. long. $73^{\circ} 15'$.

REPERCUSSION, in *Mechanics*. See *REFLECTION*.

REPERCUSSION, in *Music*, iteration, a repetition of the same note or sound.

This often happens in the modulation, where the essential chords of each mode, or of the harmonical triad, are to be struck oftener than the rest; and of these three chords, the two extremes, *i.e.* the final and the predominant one, (which are properly the repercussions of each mode) oftener than the middle one.

REPERNDORF, in *Geography*, a town of the duchy of Wurzburg; 7 miles S.E. of Wurzburg.

REPERTORY, *REPITORIUM*, a place in which things are orderly disposed, so as to be easily found when wanted.

The indices of books are repertories, shewing where the matters sought for are treated of. Common-places are a kind of repertories, very useful to the learned.

REPITORIUM Anatomicum, denotes a large hall near an amphitheatre of dissections, where skeletons, both human and brutal, are orderly preserved. Such is the repertory in the French king's garden at Paris.

REPETEND, in *Arithmetic*, is used for that part of an indeterminate or infinite decimal fraction, which is continually repeated ad infinitum.

Thus, in the indeterminate decimal fraction 317.45 316 316,316, &c. the figures 316 are called the repetend.

These repetends often arise in the reduction of vulgar fractions to decimals, thus $\frac{1}{3} = 0.3333$, &c. $\frac{1}{7} = 0.142857$, 142857, &c. $\frac{1}{11} = 0.0909$, 09, &c.

Decimals of this kind are called repeating or circulating decimals, (which see,) on account of this continual repetition or circulation of the same figures. Infinite decimals are of two kinds, which may be distinguished by the general denominations of certain and uncertain. A general infinite decimal is such whose numerator runs into infinity by a continual repetition of one or more figures, as 44, &c. 033, &c. Uncertain decimals are such, whose numerator goes on for ever without a constant circulation of figures. The essential difference between these two kinds is this; that the certain infinite decimals have a determinate, finite, and certain value, in that there is a certain determinate vulgar fraction, which expresses the true and complete value of that infinite decimal, whereas the uncertain have no such finite and assignable value: and hence the reason of the names.

REPETEND, *Single*, is that where only one figure is repeated, as in O. 3 3 3, &c.

REPETEND, *Compound*, is that where two or more figures are repeated, as in 0.09 09, &c. or in 0.142857 142857, &c.

Decimals with repetends may always be reduced to vulgar fractions; for either the repetend begins with the decimal, or not.

If the repetend begins with the first place of decimals, or if the decimal is a pure circulate, make it the numerator of a vulgar fraction, and make the denominator consist of as many 9's as the repetend has figures; or if there be cyphers between the point and repetend, with as many cyphers to the right hand of the denominator, then will this vulgar fraction be equal to the decimal.

Thus, if the repetend be single, as in o. 3333, the vulgar fraction equal to it will be $= \frac{3}{9} = \frac{1}{3}$. So if the repetend be compound, as in o. 0909, &c. the equivalent vulgar fraction will be $= \frac{9}{99} = \frac{1}{11}$.

And in like manner $o. 142857 \ 142857, \&c. = \frac{142857}{999999}$
 $= \frac{1}{7}.$

The reason is obvious from this consideration, that the decimal 0.333, &c. is $= \frac{3}{10} + \frac{3}{100} + \frac{3}{1000}$, &c. the sum of which will be equal to $\frac{3}{10}$ divided by $1 - \frac{1}{10} = \frac{9}{10}$ $= \frac{1}{3}$; and so of the rest.

If the repetend does not begin with the first place of decimals, but at some place farther on towards the right, or if it be a mixed circulate, as in the decimal $0.8\overline{333}$, &c. where the repetend does not begin till the second place of decimals, observe, that $0.8\overline{333} + \&c. = \frac{8}{10} + \frac{33}{1000} + \frac{33}{10000} + \&c. = \frac{8}{10} + \frac{1}{30} \times \frac{1}{10} + \frac{1}{30} \times \frac{1}{100} + \&c.$ But $\frac{8}{10} + \frac{1}{30} + \&c. = \frac{3}{2} = \frac{3}{2}$, as before: therefore the pro-

posed decimal is $= \frac{2}{10} + \frac{1}{10} \times \frac{1}{2} = \frac{2}{10} + \frac{1}{20} = \frac{24+1}{30}$
 $= \frac{25}{30} = \frac{5}{6}$.

Thus also if the decimal 0.22727, &c. were proposed, we shall find it = $\frac{1}{10} + \frac{1}{10} \times \frac{2}{100} + \frac{7}{1000} + \&c.$ And $\frac{2}{100} + \frac{7}{1000} + \&c.$ being $\frac{27}{1000}$ = $\frac{1}{37}$, the decimal will be =

$\frac{2}{10} + \frac{1}{10} \times \frac{1}{1} = \frac{2}{10} + \frac{1}{10} = \frac{2+1}{10} = \frac{3}{10}$. The reason
of which is obvious from what has been said.

It may, perhaps, be worth while to observe, that if the numerator of a vulgar fraction be unity, and the denominator any prime number, except 2 and 5, the decimal equal to the proposed fraction will always be a repetend, beginning at the first place of decimals; and this repetend must necessarily be a submultiple, or an aliquot part of a number expressed by as many nines as the repetend has figures; that is, if the repetend have six figures, it will be a submultiple of 999999; if four figures, it will be a submultiple of 9999, &c. From whence it follows, that if any prime number be called p , the series 9999, &c. produced as far as is necessary, will always be divisible by p , and the quotient will be the repetend of the decimal fraction $= \frac{1}{p}$. For the management of decimals

of this kind, see Malcolm's Arithmetic, book v. chap. 4.

REPETITION, REPETITIO, the reiterating of an action. See REITERATION.

Habits are acquired by the frequent repetition of actions. School-philosophers call the repetition of the same numerical effect, in another place, the replication of that effect.

REHEARSAL. The French make use of this word for a rehearsal, which the Italians call a *prova*. "Rehearsals (says Rousseau) are necessary for compositions that are to be performed in public, in order to prove whether the

several parts are correctly copied, and for ascertaining the entrances and the exits of the several characters, as well as to see that they seize the spirit of their parts, and of the entire drama. Rehearsals are likewise of use even to the composer himself, to enable him to judge of effects, and to make such changes as may seem necessary."

REPETITION, in *Musick*, denotes a reiteration or playing over again the same part of a composition, whether it be a whole strain, or part of a strain, or a double strain. The repetition is denoted by a character called a *repeat*; which is varied so as to express the various circumstances of the repetition.

REPETITION, *Reply*, is also used when, after a little silence, one part repeats or runs over the same notes, the same intervals, the same motions; in a word, the same song, which a first part had already gone over during the silence of this.

REPETITION, *Reply*, is also a doubling or trebling, &c. of an interval, or reiteration of some concord or discord.

Thus, a fifteenth is a repetition of the octave, *i. e.* a double octave, or second octave.

REPETITION of *Passages*. See ROSALIA.

REPETITION, in *Rhetoric*, is a figure by which the orator rehearses the same words or phrases over again.

Of this there are two kinds. In the first, the word is repeated precisely in the same sense: as, *Oh, Jerusalem, Jerusalem, who killest the prophets, &c. My God, my God, why hast thou forsaken me?*

Such repetitions have the same effect in discourse, with second strokes of the pencil in painting; they render the colours more strong and lively.

Sometimes the orator begins again and again with the same word, of which we have an instance in the beginning of Cicero's first oration against Catiline : *Nihilne nocturnum praesidium palatii, nihil urbis vigilae, nihil timor populi, nihil consensus honorum omnium, nihil hic manitissimus habendi senatus locus, nihil horum ora vultusque moverunt?* Where the word *nihil* so often reiterated gives an admirable force and vehemence to the discourse. Again, the same author : *Quem senatus damnarit, quem populus R. damnarit, quem omnium exisimatio damnarit, cum vos sententis vestris absolvetis?* Again, *Non seram, non patiar, non finam.*

The second kind of repetition, called *πρῶτον, place*, (which see,) is a repetition of the same word in the same phrase; but in such a manner, as that some new idea or character is added to the word in the second, which it had not in the first.

As, *Corydon is always Corydon* : *Ex illo Corydon Corydon est tempore nobis* ; by which we signify, that Corydon is no ordinary person ; and that nothing can distinguish him but the repetition of his own name : as if we should say, *he is Corydon, that is enough*. By the same figure our Saviour speaks, when he says : *Let your language be yea, yea ; and nay, nay*. See RECAPITULATION.

REPETITUM, or *Vetitum Namium*, in *Larz.* See NAMIUM.

REPHAM, or REEPHAM, in *Geography*, a market-town and parish in the hundred of Eynsford, and county of Norfolk, England, is situated at the distance of 13 miles N.W. by N. from Norwich, and 112 N.E. by N. from London. The charter for its market, which is held on Saturday weekly, was obtained by sir John de Vaux, in the fifth year of the reign of king Edward V. An annual fair, on the 29th of June, was granted at the same time. At one period this parish was remarkable for having three churches situated within one sepulchral inclosure; *viz.* Reepham, Whitwell, and Hackford; but only two of these are now standing.

The church of Reepham serves also for the village of Kerdeston, which belongs to the same lords. In this edifice was formerly a "famous image of the Virgin Mary," which, like the shrine of Diana at Ephesus, was productive of no small gains to its possessors; numerous pilgrimages having been made to it by persons of rank and affluence. Here are several monuments to the memory of different branches of the Kerdeston family. One of them, placed against the north wall of the chancel, bears the figure of a knight templar in armour, with his hands and legs crossed. It has no inscription, but is traditionally said to have been raised in honour of sir Fulk de Kerdeston, who died in 1270. Blomefield's History, &c. of Norfolk. Beauties of England and Wales, vol. xi. by John Britton, F.S.A.

REPIN, a river of Poland, which runs into the Dnieper, near Kiev.

REPITZ, or ROPITZ, a town of Saxony, in the margravate of Meissen; 2 miles N. of Torgau.

REPLANTING, in Gardening, the act of planting a second time.

The gardeners used to displant their tulips every year, and replant them. Lettuces must be displanted and replanted yearly, to make them head and knit. If strawberries, &c. be not displanted and replanted once in a few years, they degenerate.

REPLEADER, REPLACITARE, in Law, is to plead over again what was once pleaded before.

If, by the misconduct or inadvertence of the pleaders, the issue be joined on a fact totally immaterial, or insufficient to determine the right, so that the court upon the finding cannot know for whom judgment ought to be given, the court will after verdict award a replader, *quod partes replacitent*; unless it appears from the whole record that nothing material can possibly be pleaded in any shape whatsoever, and then a replader would be fruitless. (4 Bur. 301, 302.) And whenever a replader is granted, the pleadings must begin *de novo* at that stage of them, whether it be the plea, replication, or rejoinder, &c. in which there appears to have been the first defect, or deviation, from the regular course. Raym. 453. Salk. 579.

REPLEGIANDO *Homine*, *Writ de*. See HOMINE.

REPLEGIARE *de Averiiis*, a writ brought by one whose cattle are distrained, and put in a pound, by another; upon security given the sheriff to pursue, or answer the action at law against the distrainer.

REPLETION, in the Canon Law, is where the revenue of a benefice or benefices is sufficient to fill or occupy the whole right or title of the graduate who holds them.

When there is a repletion, the party can demand no more by virtue of his degrees. In England, where benefices are not appropriated to degrees, repletion, strictly speaking, has no place.

In France, by the old constitution, 600 livres, or 45l. sterling *per annum*, made a repletion, when the benefice was obtained otherwise than by a degree; and 30l. *per annum*, when it was obtained by virtue of a degree.

REPLETION, in Medicine, sometimes signifies the general fulness of the habit, which is called *plethora*; and sometimes the temporary overloading of the stomach with food and drink, which occasions particular attacks of disease, such as a fit of apoplexy, or of the gout, or a diarrhoea.

REPLEVIN, PLEVINA, in Law, a remedy granted on a distress; being a re-deliverance of the goods distrained to the first possessor, on security or pledges given by him to try the right with the distrainer, and answer him in the course of law.

If a person distress another's goods or cattle for rent, or

damage feasant, &c. the owner, upon giving security to the sheriff, that he will prosecute his action against the party distraining, and return the goods or cattle again if the seizure shall be adjudged good, may have a writ of *replevin*, or *replegiari facias*. See DISTRESS and REPLEVIN, *infra*.

REPLEVISH, is to let one to mainprise upon surety. See MAINPRISE.

REPLEVIN, REPLEVIN, (from the Latin *replegiare*, to re-deliver to the owner upon pledges of surety,) is the bringing of a writ of *replevin*, or *replegiari facias*, issuing out of chancery, by him whose cattle or goods are distrained by another upon any cause; having first given security to the sheriff, that, on the delivery of the thing distrained, he will prosecute the action against the person who made the distress.

In the stat. 24 Henry VIII. we read of *canes replegiati*, or *bounds replevied*, in a case between the abbot of St. Alban's and Geoffrey Childwic.

Goods may be replevied two ways; viz. by writ, which is that used by the common law; and by *plaint*, which is that by statute law, for the more speedy having again the cattle and goods; and is brought in the sheriff's court.

Accordingly, the statute of Marlbridge (52 Hen. III. cap. 21.) directs, that (without suing a writ out of chancery) the sheriff, immediately upon complaint made to him, shall proceed to replevy the goods. And, for the greater ease of the parties, it is farther provided by statute 1 P. & M. cap. 12. that the sheriff shall make at least four deputies in each county, for the sole purpose of making replevins. Upon application, therefore, either to the sheriff, or one of his said deputies, security is to be given, in pursuance of the statute of Westm. 2. 13 Edw. I. cap. 2. 1. That the party replevying will pursue his action against the distrainer; for which purpose he puts in *plegius de prosecute*, or pledges to prosecute; and, 2. That if the right be determined against him, he will return the distress again; for which purpose he is also bound to find *plegius de retorno habendo*. Besides these pledges, which are merely discretionary in the sheriff, the statute 11 Geo. II. cap. 19. requires that the officer, granting a replevin on a distress for rent, shall take a bond with two sureties, in a sum of double the value of the goods distrained; which bond shall be assigned to the avowant or person making cognizance, on request made to the sheriff; and, if forfeited, may be sued in the name of the assignee. The sheriff, on receiving such security, is immediately, by his officers, to cause the chattels taken in distress to be restored into the possession of the party distrained upon; unless the distrainer claims a property in the goods so taken. If this be the case, the party replevying must sue out a writ *de proprietate probanda*. But, if no claim of property be put in, or if (upon trial) the sheriff's inquest determines it against the distrainer, then the sheriff is to replevy the goods, if they be found within his county. When the goods are delivered back to the party replevying, he is then bound to bring the action of replevin, which may be prosecuted in the county-court; but either party may remove it to the superior courts. Blacklt. Comm. book iii.

REPLICATION, REPLICATIO, in Logic, the assuming or using the same term twice in the same proposition; otherwise called *reduplication*,

Some philosophers use the phrase *replicatio mundi*, replication of the world, for its conversion, or turning round. The human soul is said to be in a place *replicatively*, *replicativè*, when conceived to be all in the whole, and all in every part of it.

REPLICATION, in Law, is an exception of the second degree,

gree, made by the plaintiff to the plea or first answer of the defendant.

The replication is particularly that which the plaintiff replies to the defendant's answer in chancery; and which is either *general* or *special*. The special is grounded upon matter arising out of the defendant's answer, &c. The general is so called from the general words used in it. See *REJOINDER*, and *CONFESS* and *avoid*.

REPLIQUE, Fr. in *Musik*. This term, which implies an octave, has been, not very happily, rendered into English by *replicate*, in the wretched translation of Rameau's treatise; but though it has been generally adopted, it has never seemed properly naturalized to our language. Sir Francis Bacon has used the word *recurrence* for the same purpose, which is much more congenial with our idiom. There is necessarily a repetition of the same sound, or its octave, in every composition of four parts.

REPLIT, in *Geography*, one of the Quarken islands, in the gulf of Bothnia. N. lat. $63^{\circ} 15'$. E. long. $21^{\circ} 7'$.

REPOLON, in the *Manege*, is a demivolte, the croupe in, clofed at five times. The Italians are extremely fond of this sort of manege. In making a demivolte, they ride their horses short, so as to embrace or take in less ground, and do not make way enough every time of the demivolte.

REPOLOVSKOI, in *Geography*, a town of Russia, in the government of Tobolsk, on the Irtysh; 171 miles N. of Tobolsk.

REPOSE, Fr. in *Musik*, the answer to a subject of fugue. The answer to a fugue, and the time when it is to be introduced, are difficulties in the art of regular fugue, concerning which young contrapuntists are long doubtful. See *FUGUE* and *COUNTER-SUBJECT*.

REPORT, the relation made upon oath, by officers or persons appointed to visit, examine, state, or estimate any thing.

Damages, repairs, &c. are judged from the reports of experienced persons. Provisions for persons wounded are only granted on the reports of surgeons, &c.: in cases of rapes, a report of matrons is to be had.

REPORT, in *Law*, is a public relation, or bringing to memory, of cases judicially argued, debated, resolved, or adjudged, in any of the king's courts of justice, with the cause and reason of the same delivered by the judges. They are histories of the several cases, with a short summary of the proceedings, which are preserved at large in the record, the arguments on both sides, and the reasons the court gave for its judgment: taken down in short notes by persons present at the determination: these serve as indexes to, and also to explain, the records.

These reports, which in matters of consequence and nicety the judges direct to be searched, are extant in a regular series from the reign of king Edward II. inclusive; and from his time to that of Henry VIII. were taken by the prothonotaries, or chief scribes of the court, at the expense of the crown, and published annually; whence they are known under the denomination of the "Year-books." And it is much to be wished (says judge Blackstone) that this beneficial custom had, under proper regulations, been continued to this day; for though king James I., at the instance of lord Bacon, appointed two reporters, with a handsome stipend, for this purpose, yet that wise institution was soon neglected; and from the reign of Henry VIII. to the present time, this task has been executed by many private and contemporary hands; who sometimes through haste and inaccuracy, sometimes through mistake and want of skill, have published very crude and imperfect (perhaps contradictory) accounts of one and the same determination. Some of the

most valuable ancient reports are those published by lord chief justice Coke, which are so highly esteemed, that they are generally cited without the author's name; and are styled *αὐτὴν ἔχοντες*, *the reports*. The reports of judge Croke are also cited in a particular manner, by the name of those princes in whose reigns the cases reported in his three volumes were determined, viz. queen Elizabeth, king James, and Charles I., as well as by the number of each volume. Blackst. Com. book i. &c.

When the chancery, or any other court, refers the stating of some case, or comparing an account, &c. to a master in chancery, or other referee, his certificate therein is also called a report.

REPORTS, in *Military Matters*, are daily, weekly, and monthly reports of the state of the companies or regiments, relative to their being present or absent, on duty, sick, confined, &c.

General officers report to the commander-in-chief only. The commander-in-chief's guard reports to himself by one of his aid-de-camps. Reports of cavalry are given in to the senior generals of cavalry; and reports of infantry to the senior general officers of infantry. On a march the field officer of the piquet reports to the general of the day who leads the column; and in camp to the next superior officer to himself. A provost martial gives in his return of prisoners, and reports to the general of the day.

Deputy judge advocates, acting in districts or garrisons, &c. send in the minutes of courts martial, and report to the judge advocate general, without going through any general officers. Regimental surgeons report to their commanding officers, and surgeons in districts, &c. to the medical board.

The life-guards report, through the Gold Stick, to the king direct, from whom they receive the parole.

The foot-guards report, through the field officer of the day, to the king direct.

All other troops belonging to the British service, the marines excepted, who report to the admiralty, report through their several commanding officers, &c. to the adjutant-general and secretary at war, and to the commander-in-chief.

A *special* report is said to be made when the name of an officer is transmitted by his commander to the general of a district, independent of the regular returns; and some specific instance of misconduct is laid before him. It must be generally remembered, that every officer, on his arrival from abroad with a regiment or detachment of troops, must report himself to the governor or commanding officer of the fortress at which he arrives; and every officer who takes his passage for foreign service, must do the same previous to his departure.

The senior officer in each recruiting quarter reports weekly to the field officer of the district, the number and strength of the parties therein. The field officers commanding recruiting parties in districts, report to the inspector-general, to whom all returns and reports are to be transmitted by them, and not direct from the recruiting officers.

The various subordinate reports are those of a rear-guard, of a barrack-guard, of a quarter-guard, of a main-guard and its dependencies, &c. &c.

In the column of remarks which must accompany each of these reports, it is necessary, for the person who signs, to specify all casualties and extraordinary occurrences according to the particular nature of each report. The different hours at which the grand rounds, visiting rounds, and patrols went, must likewise be put down.

REPORT, *Pinion of*. See *PINION*.

REPOS, Fr. in *Musik*, a repose, or pause. It is the termi-

termination of a phrase or period. The repose here meant resembles a hyatus in verification; it is a cadence more or less perfect as the base falls a third, a fifth, or rises to the sixth of the key. It is a kind of resting place, determined by the sense of the passage, and by feeling. See CADENCE and CADENZA.

REPOSE, in *Poetry*, &c. See REST, PAUSE, &c.

REPOSE, in *Painting*, is applied to certain masses, or large systems of assemblages of light and shade; which, being well conducted, prevent the confusion of objects and figures; by engaging and taking up the eye so as it cannot attend to the other parts of the painting for some time; and thus leading it to consider the several groupes gradually, and, as it were, to proceed from stage to stage.

REPOSE, *In*, in *Military Language*, is a phrase that applies to troops which are allowed to be stationary for any given period, during an active campaign, either through sickness, or from some other cause.

REPOSITION of the Forest (formed from *re*, and *ponere* to lay again), an act by which certain grounds, before made purlieu, are, upon a second view, laid to the forest again.

REPOSITION, in *Surgery*, the reduction of a bone.

REPOSITORY, REPOSITORIUM, a store-house or place where things are laid up and kept. In which sense we say, the repository of the royal society, the royal repository at Woolwich, containing models of every sort of warlike stores, &c. See MUSEUM.

REPOSITORY of Farm Manure, in *Rural Economy*, the place where it is put or laid up. See RECEPTACLE of Stall Manure.

REPOSO, in *Geography*, a small island near the coast of Brazil; S. lat. 19° 36'.

REPPELE, a town of Hinder Pomerania; 7 miles W.S.W. of Zachau.

REPPIN, a town of Brandenburg, in the New Mark, on the Eylang; six miles S.S.W. of Drossen, N. lat. 52° 25'. E. long. 15° 2'.

REPREHENSION, in *Rhetoric*. See PARRHESIA.

REPRESENTATION, REPRÆSENTATIO, in the *Drama*, the exhibition of a theatrical piece; including the scenes, machines, recitation, &c.

Sir Richard Steele's principle is, that the design of a play is not to be read but represented; so that it is on the stage, not in the press, it is to be judged of; and that the pit, not the public, are the proper judges.

REPRESENTATION, in *Law*. See DESCENT, Right of CROWN, INTESTATE, ADMINISTRATION, and PARLIAMENT.

REPRESENTATION, in *Insurance*, is understood to mean a collateral statement, either by parol or in writing, of such facts or circumstances relating to the proposed adventure, and not inserted in the policy, as are necessary for the information of the insurer, to enable him to form a just estimate of the risk. Such representations are often the principal inducement to the contract, and afford the best ground upon which the premium can be calculated. A representation may be untrue, either wilfully and fraudulently; or inadvertently and innocently.

A wilful misrepresentation, or *allegatio falsi*, in any fact or circumstance material to the risk, is a fraud that will always avoid the contract. As if an agent, knowing that a ship had failed from Jamaica for London on the 24th of November, effect an insurance on the voyage, and tell the underwriter that the ship failed in December: this is a fraud, and the policy is void.

And such misrepresentation so completely vitiates the policy, that the insured cannot recover upon it, even for a

loss arising from a cause unconnected with the fact or circumstance misrepresented. As if the insured represent that the ship or goods insured are neutral property, when in fact they are enemy's property; he shall not recover even for a loss occasioned by shipwreck.

So it would be if the broker or agent were to assert that a ship or goods were neutral property, without knowing whether this were true or false, and they are, in fact, enemy's property: for, though it may not, perhaps, be equally criminal *in foro conscientie* for a man to aver that to be true which he knows nothing of, as to aver that to be true which he knows to be false; still it is unquestionably a fraud, and in the case of an insurance, equally injurious to the underwriter; because he is induced by the deception, however occasioned, to compute the risk upon false principles. The same reasoning holds even in the case where the person himself making the representation believes it to be true.

But if he were only to say that he believes the ship to be neutral property, knowing nothing on the subject, and having no reason to believe the contrary; there, though the ship be not neutral, the representation will not avoid the policy; because the underwriter may inform himself of the grounds of this belief, before he enters into the contract; and if he neglect to do so, he takes upon himself the risk of its being unfounded.

For the same reason, if the word *expelled* be used, this will not amount to a representation: as when a broker in getting insurances effected on several ships, belonging to the same owner, and speaking of them all, said, — 'Which vessels are *expelled* to leave the coast of Africa in November or December,' when, in fact, they had all failed in the May preceding: this does not amount to a representation, being only an *expectation*, the ground of which the underwriter might have enquired into.

There is a material difference between a representation and a warranty. A warranty, being a condition upon which the contract is to take effect, is always a part of the written policy, and must appear on the face of it: whereas a representation is only matter of collateral information or intelligence on the subject of the voyage insured, and makes no part of the policy. A warranty, being in nature of a condition precedent, must be *strictly and literally* complied with; but it is sufficient if a representation be true in *substance*. By a warranty, whether material to the risk or not, the insured stakes his claim of indemnity upon the precise truth of it, if it be affirmative, or upon the exact performance of it, if executory; but it is sufficient if a representation be made without fraud, and be not false in any material point; or if it be *substantially*, though not *literally*, fulfilled. A false warranty avoids the policy, as being a breach of a condition upon which the contract is to take effect, and the insurer is not liable for any loss though it do not happen in consequence of the breach of the warranty. A false representation is no breach of the contract, but if material, avoids the policy on the ground of *fraud*, or at least because the insurer has been misled by it.

It has already been shewn that a warranty must appear upon the face of the policy, and make a part of the written contract; and therefore a written paper, wrapped up in the policy, or even wafered to it, is only a representation. For the same reason, the written instructions for effecting the policy, unless inserted in it, cannot be deemed a warranty, but only a representation; for the underwriter, by not insisting on having these instructions inserted in the policy, shews that he is content to take them as a representation.

But it behoves all agents and brokers concerned in the effecting of policies, to keep correct entries of these instructions, and indeed of all representations made to the under-writers: for the whole question between the insured and the under-writers often turns upon these instructions. Besides, they are answerable to the insured for the consequences of any representation made by them without authority, as well as for those of omitting to make such representations as they have been instructed to make.

By an extension of equitable relief in cases of fraud, it seems to be now settled that if a false representation be made to the first under-writer on the policy, in a material point, this shall be considered as a misrepresentation made to every under-writer, so as to infect the whole policy, otherwise it might be a contrivance to deceive many; for when a respectable under-writer stands first on the policy, the rest subscribe the policy without asking a question; and if the first under-writer be imposed upon, the rest are entrapped by the same fraud.

But the insurer must avail himself of this sort of objection in the first instance; for after a verdict has been obtained, the court will not set it aside upon an affidavit of the first under-writer, that a material misrepresentation had been made to him. The defendant, in such case, knows what has been represented to himself, and might have known what had been represented to the first under-writer; and he shall not lie by till after a trial, in order to make the objection, if the verdict should be against him.

If the insured state his computation as *facta*, instead of the information on which he founds his computation, and it prove untrue, it is a misrepresentation; and if material, it will avoid the policy.

A misrepresentation in a material point equally vitiates the contract, whether it be the misrepresentation of the insured himself or of his agent, and whether it proceed from fraud, mistake or negligence; for the insurer is thereby led into an error, and computes the risk upon false grounds.

As a representation is only matter of collateral information, it is sufficient if it be true in *substance*; and its not being inserted in the policy in the form of a warranty, is looked upon as a proof that the insurer does not require it to be strictly and literally true. Although the voyage be represented as being less than the voyage described in the policy, yet, if there be no fraud, and the voyage actually performed be within the policy, it will be protected by the policy. Even if a representation as to the course of the voyage be literally untrue, yet if it be made in conformity to an established usage of trade, and no person be deceived by it, and the voyage meant to be performed be within the policy, it will not avoid the contract.

Every representation respecting the state of the ship, and the time of her sailing, is material; and therefore if it be stated that a ship was *ready to sail* on a certain day, when, in fact, she had sailed the day before, this is both a misrepresentation and a concealment, and will avoid the policy.

Concealment, or "*suppressio veri*," is nearly allied to misrepresentation, or "*allegatio falsi*," and consists in the fraudulent suppression of any fact or circumstance material to the risk; and this, like every other fraud, avoids the contract *ab initio*, upon principles of natural justice. But it is not merely on the ground of *fraud* that a concealment avoids the contract; for even a concealment which is only the effect of accident, negligence, inadvertence, or mistake, will be equally fatal to the contract, as if it were intentional and fraudulent. Whatever respects the state of the ship, the time of her sailing, the nature of the employ in which she is to

be engaged, &c. ought to be fully disclosed; and the keeping back of any part of this fact will be fatal to the contract. In such case, the concealment so vitiates the policy that it will afford the insured no remedy, even for a loss arising from a cause unconnected with the fact or circumstance concealed; for a concealment is to be considered, not with reference to the event but to its effect, at the time of making the contract. A well-founded suspicion of concealment will amount in the courts to proof of fraud. As it is in some cases necessary to state to the under-writers the nature of the service in which the ship is to be employed; if this be attended with any extraordinary danger, the concealment of it will avoid the policy. A material concealment is fatal, though the fact concealed was not disclosed, because the broker thought it immaterial. Doubtful rumours respecting the safety of a ship which it is intended to insure "*lost or not lost*," ought to be faithfully disclosed to every under-writer; and the withholding of such information will avoid the contract. The obligation of a strict observance of good faith is equally binding on both parties in all contracts; and in that of insurance, the under-writer, as well as the insured, is bound to disclose all circumstances within his knowledge affecting the risk. If, therefore, it should appear, that at the time when he underwrote the policy, he knew that the ship was arrived safe, the contract will be void as to him, and an action will lie against him to recover back the premium.

There are, however, many matters, which are open to both parties, and upon which they may both exercise their judgments, with regard to which they may be innocently silent. The insured need not disclose what the under-writer knows, or what he ought to know. The under-writer needs not be told what lessens the risk agreed upon, and is understood to be comprised within the terms of the policy. He is bound to know every cause which may occasion natural perils, as the difficulty of the voyage, the variation of seasons, the probability of lightning, hurricanes, &c. He is also bound to know every cause which may occasion political perils, from the rupture of states, from war, and its various operations; and he is bound to know the probability of safety from the continuance and return of peace, from the imbecility of the enemy, the weakness of their counsels, or their want of strength. There are other circumstances which the under-writer ought to know; and, particularly, it is not necessary to communicate to him, that the ship is foreign built, though this enabled her to sail without convoy, and without a licence to do so, being within the exception in the stat. 38 Geo. III. c. 76. § 6; it being the business of the under-writer to obtain this information for himself. In cases of concealment, the question must always be, whether there was, under all the circumstances, at the time when the policy was underwritten, a full and fair statement, or a concealment: fraudulent, if designed; or, though not designed, varying materially the object of the policy, and changing the risk understood to be run; and in both cases avoiding the contract. It is not necessary that there should be any previous representation as to the state of the ship, that being covered by the implied warranty that she is sea-worthy. For a variety of other particular facts and documents, relating to the subjects of representation and concealment, we refer to Marshall's Treatise on the Law of Insurance, vol. i. b. i. ch. 9 and 10. See WARRANTY.

REPRESENTATIVE, one that personates, or supplies the place of another; and is invested with his right and authority.

The word representative is equivalent to procurator or proxy.

The commons are the people's representatives in *parliament*; which see.

There is this defect in the constitution of our parliament; that whereas all Englishmen who have considerable estates ought not to be taxed without their own consent in parliament, by themselves, or their representatives; copyholders, of whom some have a thousand pounds a-year, have no voice in the election of knights of the shire. See *PARLIAMENT*.

REPRESENTATIVE Character, in *Political Economy*, thus denominated by way of excellence, or in contradistinction to other kinds of representation, constitutes the ambassador, or minister of the first rank, who represents his master in his very person and dignity. It places him above all other ministers, who are not invested with the same character, and precludes their entering into competition with the ambassador. (See *EMBASSADOR*.) Envoys are ministers of the second rank, and are not invested with the representative character, properly so called, or in the first degree. See *ENVOY*.

REPRESENTATIVE Power, in *Metaphysics*, a term introduced by Leibnitz, to signify that power of the human soul, by which it represents to itself the universe, according to the situation of the body in the universe.

Wolffius calls this power *vis representativa*, to denote its being an active power, or rather a force actually exerting itself. For he expressly says, *quod vis consistat in continuo agendi conatu*. And he thinks that from this principle of a *vis representativa*, every phenomenon of the human mind may be accounted for. See his *Psycholog. Ration.* art. 529.

But it may be presumed, that many will find this principle too obscure to be admitted.

When it is said, that our ideas are representative of things without us, or of the universe; it may be asked in what sense this is to be understood? Do they represent it, 1. As a picture does its original? Or, 2. As an effect of a cause? Or, 3. As a sign represents the thing signified? The first opinion is exploded in part by Locke and the Cartesians, and totally by Dr. Berkeley, late bishop of Cloyne. The second is admitted by Hobbes, but denied by Leibnitz himself and the idealists. The third should seem to be the opinion of Leibnitz, but he is not sufficiently explicit.

Dr. Berkeley admits ideas to be signs; but according to him they are arbitrary signs, depending on the immediate will of the Deity: hence the visual language; and ideas only signify or suggest each other, and spirits; but not bodies, the existence of which is totally unknown.

REPRIEVE, or *REPRIVE*, from *repandre*, to take back, in *Law*, a suspending or deferring the execution of the law upon the prisoner for the present time.

A reprieve is properly a warrant from the king, for suspending the execution of a person condemned.

This may be, first, *ex arbitrio judicis*, either before or after judgment; as, where the judge is not satisfied with the verdict, or the evidence is suspicious, or the indictment insufficient, or he is doubtful, whether the offence be within clergy; or sometimes, if it be a small felony, or any favourable circumstances appear in the criminal's character, in order to give room to apply to the crown for either an absolute or conditional pardon. These arbitrary reprieves may be granted or taken off by the justices of gaol-delivery, although their session be finished, and their commission expired; but this rather by common usage than by strict right. (2 Hal. P. C. 412.) Reprieves may also be *ex necessitate legis*, as where a woman is capitally convicted, and pleads her pregnancy; which is referred to a *jury of matrons*. Another cause of regular reprieve is, if the offender become

non compos between the judgment and the award of execution. See *LUNATIC*.

REPRIMAND, a sharp authoritative reproof. Such a person was reprimanded in court by the bench, &c.

REPRIMAND, a military punishment at the head of a regiment, is sometimes ordered by a court-martial, and sometimes only in the presence of the officers of the corps: it is generally given by one of the field-officers, and usually in such terms as these: "Captain, or lieutenant A. B., you have been tried for —, and are, by the sentence of a general court-martial, found guilty thereof, and sentenced to be reprimanded at the head of the regiment: the disagreeable task of doing it is assigned to me: I therefore do hereby reprimand you, and hope, that it may prevent your falling again into the like error." Non-commission officers are sometimes, though not frequently, ordered to be reprimanded.

REPRISALS, or *REPRIZALS*, *Reprisalia*, in the *Civil Law*, a right which princes have to retake from their enemies such things as they unjustly detain from them; or other things equivalent to them.

The word is formed from the Italian *represaglia*, which signifies the same thing.

When a place is taken or held from a prince, he seizes another by way of reprisal. Sometimes he takes men of the opposite party, by right of reprisals.

The Romans called this *clarigatio*; and the Greeks had something like it under the name of *androlepsia*.

Reprisals are used between nation and nation, to do justice to themselves, when they cannot otherwise obtain it. If a nation has taken possession of what belongs to another; if it refuses to pay a debt, to repair an injury, or to make a just satisfaction; the other may seize what belongs to it, and apply it to its own advantage, till it has obtained what is due for interest and damage, or keep it as a pledge till full satisfaction has been made. The law of nations permits reprisals only upon a cause that is evidently just, as for a debt that is extremely clear. For he who forms a doubtful pretension, can at first demand only an equitable examination of his right. In the second place, he should, before he proceeds so far, have in vain demanded justice, or, at least, have the utmost reason to believe that it would be in vain for him to demand it. Then alone he may right himself. It would be too contrary to the peace, to the repose, and safety of nations, to their mutual commerce, and to the duties which bind them to each other, for any prince suddenly to apply to force, without knowing whether the other is disposed to do him justice, or to refuse it. It must be observed, in order perfectly to understand this article, that if, in a litigious affair, our adversary refuses the means of bringing the right to proof, or artfully eludes it; if he does not, with good faith, apply to pacific measures for terminating the difference; and, above all, if he is the first who begins acts of hostility, he renders the cause just, which was before doubtful: we may then make use of reprisals, or seize his effects, to oblige him to embrace the methods of reconciliation, which the law of nature prescribes. This is the last attempt before coming to an open war. As the wealth of the citizens forms a part of the total wealth of a nation, and between state and state, whatever is the property of the members is considered as belonging to the body, and is answerable for the debts of the body; it follows, that in reprisals they seize the goods of the subject, in the same manner as those of the state, or sovereign. Every thing that belongs to the nation is subject to reprisals, as soon as it can be seized, provided it be not a deposit trusted to the public faith. This deposit is found in our hands, only

only in consequence of that confidence which the proprietor has put in our good faith; and it ought to be respected, even in cases of open war. Thus it has been usual to behave in France, England, and elsewhere, with respect to the money which foreigners have placed in the public funds. He, however, who makes use of reprisals against a nation, on the goods of its members indiscriminately, cannot be taxed with seizing the wealth of an innocent person for the debt of another; for, in this case, the sovereign is to recompense those of his subjects on whom the reprisals fall: this is a debt of the state or nation, of which each citizen ought only to support his quota. It belongs only to sovereigns to use and order reprisals, in the manner now stated. This is a measure of too great consequence to be abandoned to private persons. In all civilized states, a subject who thinks himself injured by a foreign nation has recourse to his sovereign, in order to obtain the permission of making reprisals. This is what is called desiring "letters of marque." See the next article.

We may use reprisals against a nation, not only for the actions of the sovereign, but also for those of his subjects. Accordingly the sovereign demands justice, or makes reprisals, not only for his own affairs, but also for those of his subjects, whom he ought to protect, and whose cause is that of the nation. But to grant reprisals against a nation, in favour of foreigners, is to set himself up as a judge between that nation and these foreigners, which no sovereign has a right to do.

As we may seize the things which belong to a nation, to oblige it to do justice, we may, for the same reason, arrest some of the citizens, and not release them till we have received entire satisfaction; the subjects thus detained being only regarded as a security to oblige a nation to do justice, if their sovereign is obstinate in refusing it. We cannot take away their lives, nor inflict any corporal pain upon them, for a refusal of which they are not guilty. But the sovereign may make use of force against those who resist the execution of this right, and use as much as is necessary to surmount their unjust resistance. In this case, the true and just welfare of the state is the grand rule: moderation is always laudable in itself; but the conductors of nations ought to exercise it only so far as it is consistent with the happiness and safety of their people. A sovereign, however, has no right to oppose force, or to make war against him, who, in such a case, by ordering the making of reprisals, only exercises his just right. Whenever a sovereign can, by the way of reprisals, procure a just recompence, or a proper satisfaction, he ought to make use of this method, which is less violent and less fatal than war. Those who run to arms, says the excellent Vattel, without necessity, are the scourges of the human race, barbarians, enemies to society, and rebels to the law of nature, or rather to the common father of mankind. There are cases, however, in which reprisals would be justly condemned, even when a declaration of war would not be so; and these are precisely those in which nations may with justice take up arms. When it relates to differences, not on an act of violence, or of an injury received, but of a contested right; after having in vain attempted ways of reconciliation, or pacific measures of obtaining justice, it is a declaration of war which ought to follow, and not pretended reprisals, which, in such a case, would only be real acts of hostility, without a declaration of war, and would be contrary to the public faith as well as to the mutual duties of nations.

There is one kind of retortion sometimes practised in war, under the name of reprisals, which we must here mention. If a general of the enemy has, without any just reason,

caused some prisoners to be hanged, a like number of his men, and of the same rank, will be hung up; signifying to him, that this retaliation will be continued for obliging him to observe the laws of war. It is a sad extremity thus to put a prisoner to death for his general's fault; and if this prisoner was before promised his life, reprisals cannot be made on him with any colour of justice. Yet as a prince, or his general, has a right of sacrificing the life of his enemies to his safety, and that of his men, if he is engaged with an inhuman enemy, who frequently commits such enormities, he appears to have a right of refusing life to some of the prisoners he may take, and of treating them as his were treated. But Scipio's generosity is rather to be imitated. That great man, having reduced some Spanish princes, who had revolted against the Romans, declared to them, that on a breach of their faith, he would not call the innocent hostages to an account, but themselves; and that he would not revenge it on a disarmed enemy, but on those who should be found in arms. (Liv. l. 28.) Alexander the Great, having cause of complaint against Darius for some malpractices, sent him word, that if he continued to make war in such a manner, he would pursue him to the utmost, and give no quarter. (Quint. Curt. l. iv. c. 1, and 11.) It is thus an enemy, violating the laws of war, is to be punished, and not by causing the penalty due to his crimes to fall on innocent victims. Vattel's Law of Nations, b. ii. ch. 18. b. iii. ch. 8.

REPRISALS is also used for a letter or permission, which a prince sometimes gives a subject, upon a full cognizance of the cause; authorizing him to retake from the first persons he meets of the opposite party, as many effects as make an equivalent to what have been violently forced from him, and for which the opposite prince has refused to do him justice.

These permissions are also called *letters of marque*, or *mart*; and in the stat. 27 Edw. III. *law of marque*; in regard a person denied justice in another man's territory, redresses himself by goods belonging to men of that territory. See *Letters of MARQUE*.

REPRISALS is also used in the same sense with recapture.

REPRISE, or REPRIZE, in the *Commerce by Sea*, a merchant-ship, which, having been taken by a corsair, privateer, or other enemy, is retaken or recovered by a vessel of the contrary party.

The word is French, and signifies a *resumption* or *re-taking*.

When a vessel, thus retaken, has been twenty-four hours in the hands of the enemy, it is deemed a lawful prize. If the reprize has been made within twenty-four hours, the vessel is to be restored to the proprietor, with every thing in it, upon his allowing one-third to the vessel who made the reprize.

If the reprize has been abandoned by the enemy, either in a tempest, or from any other cause, before it have been led into any port, it is to be restored to the proprietor. See *RECAPTURE*.

REPRISE, in the *Manege*, is a lesson repeated, or a manege recommenced. Thus we say, to give breath to a horse upon the four corners of the volte with only one reprize, that is, all with one breath.

REPRISE, Fr., in *Musick*. Every part of an air or strain that is to be repeated, without being written or printed twice over, is called by the French a reprize. There are various ways of marking repetitions in music: first by a double bar dotted; if on both sides, both parts or strains are

are to be repeated; if only one side of the double bar is dotted, that side only is to be repeated. This sign S. , and sometimes *da capo al segno* S. , imply a repetition of particular portions of a melody; as do, likewise, dots in the spaces of the staff. (See *RENOU* and *REFERENCE*.) Gretry, in his *Memoires*, says that the repeating of the first and second parts or strains of a movement is a barbarous custom.

REPRIZES, in *Law*, are deductions, drawbacks, or duties, paid yearly out of a manor, or lands. Such are rent-charges, pensions, fees of stewards or bailiffs, &c. The manor of Doll yields 40*l.* *per annum*, *ultra reprizas*, besides all reprizes.

REPROBATION, *REPROBATIO*, in *Theology*, a decree or resolve, which God has taken from all eternity to punish sinners, who shall die in impenitence.

Reprobation stands in direct opposition to *election*.

Divines hold it a symptom of reprobation, when a sinner is hardened so as not to feel any farther remorse or misgivings of conscience.

The casuists distinguish two kinds of reprobation, *positive* and *negative*. *Positive* is that by which God is supposed to create men with a positive and absolute resolution to damn them eternally. This opinion of reprobation is countenanced by St. Augustine, and others of the fathers; and is strongly maintained by Calvin, and most of his followers. Something like it is also found in the thirty-nine articles of the church of England; but it is now generally exploded, as injurious to the justice of God. *Negative* or *conditional* reprobation is that by which God, though he creates all men with a sincere desire to save them, and furnishes them with the necessary means thereto, so that all may be saved, if they will; yet sees there are several who will not do it, with the aids he shall afford them, how powerful soever; and sees, at the same time, they would do it with certain other aids, which he sees, but will not give them. *O altitudo!* &c.

By comparing one part of scripture with the other, says Dr. Doddridge in his "Lectures," (Prop. 142, schol. 1.) there seems to be this remarkable difference between the predestination to life and that to death (here called reprobation), that, in the former case, God determines by the influence of his grace to work such a change in the hearts of his elect, as that their salvation should on the whole be ascribed to him, and not unto themselves; whereas he determines to bring others into such circumstances, that though their ruin should in fact happen, yet they themselves should be the authors of it, and the blame lie as entirely upon themselves, as if it had not been so much as foreknown. (See Rom. ix. 22, 23. Matth. xxv. 34, 41.) But the opposers of this doctrine allege, that this kind of reasoning is an evasion and not a solution of the difficulty. This learned divine, adverting to the objection, that the above-stated doctrine tends to make the persons whom it concerns desperate, observes, that if it be granted, that *sufficient* assistances are given to *all*, none will have reason to despair, nor will any have an excuse to plead before God, in consequence of his secret purposes, which will not be made a rule of his final judgment. If it be said, that nevertheless those who are not predestinated to life are left under a necessity of perishing, and an impossibility of salvation; it must be owned, that it is difficult to say, how the doctrine, as explained by some, can be freed from this objection; but that this consequence does not necessarily follow from it, according to his state-

ment. See *ELECTION* and *PREDESTINATION*. See also *SUBLAPSARIAN* and *SUPRALAPSARIAN*.

REPRODUCTION, in *Physiology*. In speaking of the growth of organic bodies, we must notice their power of reproduction; that wonderful property of restoring or renewing parts that have been mutilated or entirely lost. This is one of the most important provisions of nature, inasmuch as it guards animals and plants against the multiplied dangers to which their bodies are exposed. Hence, when viewed in connection with the system of nutrition altogether, it forms one of those decisive and grand characters, which distinguish at once the machines that proceed from the hand of the Creator, from all, even the most ingenious and boasted, productions of human skill. The difference is recognised at the first glance; the distance is immeasurable. The springs and wheels of mechanical instruments have no power of repairing themselves, when they are bent, broken, worn, or spoiled; but such a faculty is enjoyed in various degrees by every animal and by every plant.

At different periods of the year, several organised beings lose, by a spontaneous and natural process, certain parts of their body, which are subsequently renewed. Examples of this occur in the fall of the stag's horns; in the moulting of birds; in the renewal of the cuticle of serpents, and other amphibia, of the larvæ of insects, and of the shell of the crustacea; the fall of the leaves of trees, &c. This may be called ordinary or natural reproduction. The stag's horn, or antler, as it should be more properly called, is a mass of true bone, possessing the structure and characters of osseous substances. In its early state, it is soft, and traversed by large vessels, which must be reproduced every time the new horn is formed. This annual reproduction constitutes, in many points of view, one of the most remarkable phenomena of animal physiology. It affords a most striking proof, 1st, of the power of the nutritive process, and of the rapid growth, which is dependant on this in warm-blooded animals. For the horn of a stag, which may weigh a quarter of a hundred, is completely formed in ten weeks. 2dly. Of a limited duration of life in a part of an animal, entirely independent on the life of the whole animal, which in the stag extends to about thirty years. 3dly. Of change of calibre in particular vessels. For the branches of the external carotid, which supply the horn, are surprisingly dilated during its growth; and recover their former area, when that process has ceased. 4thly. Of a peculiar sympathy, which is manifested between the growth of the horns, and the generative functions. For castration, or any essential injury of the organs of generation, impedes the growth, alters the form, or interrupts the renewal of the horns. See the articles *CERVUS*, and *HORN*, in *Comparative Anatomy*.

The cuticle of the snake is separated every year, and comes off as a complete sheath, excepting the aperture, through which the animal escapes: the covering of the cornea is shed with the rest of the external integument.

Crustaceous animals (the crab, lobster, &c.) have a skeleton, which furrounds and contains their soft parts, and which serves, at the same time, the purposes of a skin. When it has attained its perfect consistence, it grows no more; but, as the soft parts still increase, the shell separates, and is detached, being succeeded by a larger one. The calcareous bodies in the stomachs of these animals, performing the office of teeth, are shed with the shell. See the article *CANCER*, in the account of the species *ruricola*, and *gammarus*.

The larvæ of insects cast their cuticular covering several times before their transformation. An interesting account of

the particulars may be seen in the article ENTOMOLOGY, in the division "*of the larva state*," under the subdivision "*lepidoptera*."

The second, or *extraordinary* kind of reproductive power, is that by which wounds, fractures, or any accidental mutilation or loss of parts of an organized body, are remedied or restored. This exists in very different degrees in different departments of the animal kingdom. In man, and such animals as are nearly allied to him, the property is very limited, although sufficiently active to be capable of remedying the effects of great injuries. If a bone be broken, a muscle or tendon divided, or a piece of skin destroyed, processes are set up in the parts by which restoration is accomplished. The ends of the bone are joined by an osseous substance, which gives to the part its original solidity; the tendon regains its firmness and power of resistance; the muscle can contract again and move the points of its attachment; and the surface of the body is covered by a new piece of integument. The functions of the parts are restored; but the newly formed matter can be always distinguished from the original composition of the body, and possesses a weaker vitality. For, in some cases, old ulcers have broken out afresh, and even fractures have been disunited in states of great general debility. A divided nerve is reunited, even if a small portion be removed: and the function of the part, suspended for a time, is thus restored. The case is different in the blood-vessels: the processes consequent on wounds of these tend to stop the hemorrhage, which in general can be effected only by the obliteration of the tube.

The power of repairing the effects of injury is modified by various circumstances. The health and strength of the individual, the age, the air, and other circumstances, which the surgeon must attend to, have great influence.

In the cases which have been just mentioned, the restorative power repairs injuries; but it goes no further. Neither in man, nor in any warm-blooded animals, are entire organs ever reproduced. If a limb be cut off, or a piece of flesh taken away; the wound is healed, the chafin is filled up; but the lost parts are never formed again.

In the lower orders of the animal kingdom, on the contrary, such are the strength and perfection of the reproductive energy, that considerable members are formed again, and we can hardly assign a limit to the power in some instances. The lower we descend in the scale of beings, the more surprising are the manifestations of this reproductive faculty. It is familiarly known, that the claws of the crab and lobster, and the entire limbs or tail of the newt, can be restored: the same holds good of the rays of the star-fish (asterias), and the arms or tentacula of the cuttle-fish. It was asserted by Bonnet and Spallanzani, that the entire head of the snail can be reproduced; but the assertion was suspected, because other experimentalists did not succeed in repeating the trials. Hence Blumenbach was led to observe, "that some experiments on this reproductive power require a hand exercised in such employments, together with various precautions, and a favourable combination of circumstances, for their success. Hence persons must be cautious in concluding against the truth of any statement, because their own experiments do not succeed. After several fruitless attempts on this subject, I have lately succeeded in observing the reproduction of the whole head of the snail (*helix pomatia*) with its four horns, which occupied about six months." *Comparative Anatomy*, translated by Lawrence, p. 219.

The same physiologist has given us a remarkable instance of reproduction in an animal of more complicated structure.

"I preserve," says he, "in spirits a large water newt (*lacerta palustris*), from which I extirpated nearly the whole eye several years ago: all the humours were discharged, and then four-fifths of the emptied coats were cut away. In the course of ten months an entirely new eye-ball was formed, with cornea, iris, crystalline lens, &c.; and this is only distinguished from the same organ on the opposite side by being smaller." *Ibid*.

Not only are amputated tentacula speedily replaced in the actinia (sea anemones), but, if the animal be divided by a vertical or horizontal section into two halves, each of these becomes an entire actinia. See the article ANEMONE.

The fresh water polype exhibits very surprising powers in this way. If it be cut into two or more pieces, these become perfect animals. If it be slit half way down, the two halves are rendered perfect, remaining united below: these may be slit again with the same results. The opposite ends of two polypes may be made to grow together, &c. See POLYPE.

See the memoirs on animal re-productions in Spallanzani's tracts: also the works of Bonnet.

REPROOF, OBJURGATIO, in *Rhetoric*, is distinguished from *invective*; which see.

REPS, in *Geography*, a town of Transilvania; 16 miles N. of Fogaras.

REP-SILVER, money anciently paid by servile tenants to their lord, to be quit of the duty of reaping his corn.

REPTILES, in *Comparative Anatomy* and *Physiology*. Although the animals, whose structure we are about to explain, are perfectly similar to each other in their principal characters, and ought therefore to be united in one class, naturalists have experienced a real difficulty in discovering an appropriate name for the class. That of *amphibia*, employed by Linnæus and his disciples, although deduced from a striking circumstance in the economy of the more generally known reptiles, namely, the power of existing for a long time in water, as well as in air, is vague and uncertain in its signification. If we regard as *amphibia* those aquatic animals, which are able to live for some time on land, or those land animals, which can remain for a certain time under water, all animals are amphibious; for even the human subject and the mammalia can dive. If, on the other hand, the word *amphibious* be taken etymologically, and understood to denote an equal power of subsisting in air and water, it is applicable to no animals. Although reptiles can remain much longer under water than the mammalia, or birds, they are obliged, as their respiratory organs are only calculated for breathing air, to come sooner or later to the surface for this purpose; and they are drowned, like any warm-blooded animal, if detained in the water beyond that time. To enable an animal to exist equally in air and water, it should have lungs and gills; that is, it should have the power of breathing air, like the mammalia and birds, and of breathing water, like fishes; and it should be able to use either of these methods, to the exclusion of the other. But we know of no such animals. The larvæ of frogs and salamanders, the proteus anguinus, and the firen lacertina (see the latter part of this article), have indeed branchiæ and lungs; but as far as our knowledge hitherto goes, none of these could live out of the water. The lungs of the tadpole, and of the larvæ of salamanders, are designed for the service of those animals in their subsequent stage of existence; but do not give them the power of living in air: and the lungs, either of the proteus or firen, do not seem sufficient to enable them to dispense with the office of the branchial appendages. In its etymological sense, then, the term *amphibious* is not applicable to any animals we know of.

Linnæus

REPTILES.

Linnaeus places among his amphibia reptiles who never go into the water, and some fishes which never quit it. He could not fail to experience great difficulties in naming a class so ill conceived as that of his amphibia; consequently, this appellation is objectionable, as being vague and obscure; the genera comprehended in the Linnæan class amphibia, are too ill assorted to admit of their having a common name suitable to all. Daubenton divided them into two classes, naming one oviparous quadrupeds, and the other serpents. Lacépède adopted these two classes, and placed between them a third, that of oviparous bipeds. Hermann of Strasbourg, in his "*Tabulæ asinitatum Animalium*," proposed to substitute, for the term amphibia, that of cryerozoa. "Si in novorum nominum impositione gloriam more multorum quæreremus, et ea re scientia promoveretur, cryerozoa apte vocari posse putaremus, quia omnem fere naturam eorum animalium vox ista exhaurire videatur. *Κρυεροζοα*; enim non modo frigidum, sed et horridum luridumque significat." Hermann, *Tab. affin. Anim.* p. 218.

Without entering further into the objections against the appellations just enumerated, we adopt that of reptiles, already employed by many modern naturalists, and particularly by Cuvier, in his "*Tableau Élémentaire d'Histoire Naturelle*." In fact, in the progression of the oviparous quadrupeds, as well as in that of serpents, the belly moves against the surface of bodies, over which they pass.

General Observations.—Referring to the article CLASSIFICATION for a view of the genera comprehended under these divisions, we prefix to the more detailed survey of the anatomy of reptiles, a short summary of the principal anatomical characters of the four orders into which the class is divided.

1. THE CHELONIAN order; Testudines. Body inclosed in a bony shell. They resemble birds in having the masticating surfaces of their maxillary bones covered by strong cutting horny plates. Body supported on four limbs, terminated by a tail, and covered in almost all by scales. They copulate; fecundation takes place internally: the female lays eggs, covered by a firm calcareous shell: the young animals come out without incubation, merely by the heat of the atmosphere; and they undergo no metamorphosis. Stomach larger than in the other reptiles, and intestinal canal furnished with a cæcum. The heart has two auricles.

2. SAURIAN order, or Lizard kind. They resemble the former very nearly in the structure of their principal internal organs. They have firm bones, like those of the mammalia: curved and long ribs, and a sternum. Teeth set in the jaw. The two branches of the lower jaw consolidated. A trachea composed of cartilaginous rings, an os hyoides and larynx, capable of producing sounds, at least in some individuals. Heart with two auricles. A simple penis in the male. There is a real internal copulation; the female lays separate eggs, generally covered with a firm shell, depositing them on dry ground, or in holes. The young ones come out of them, and undergo no metamorphosis. The skin is furnished with numerous plates or scales. Body elongated, and ending with a tail. Feet, often high, and strong enough to sustain the body above the ground in progression. Some are quadruped; others biped, having either fore or hind feet. Toes furnished with nails: generally five in number; but there may be four, three, two, and even one.

3. OPHIDIAN order; Serpents. They agree with the two former orders, in having firm bones, curved and long ribs, a larynx and trachea, capable of producing a slight hissing in moist. An external organ of generation in the male. A real internal copulation: the female lays eggs covered with a calcareous shell, which she deposits in holes filled with leaves,

under the roots of trees, in warm and rather moist situations. The young ones, when they quit the egg, are like their parents. They differ from the preceding orders, in having a long, eel-shaped, flexible body, covered with a skin, either furnished with scales or plates, or naked, unprovided with feet, and terminated by a tail, often very long. Numerous long curved ribs, not united together, as there is no sternum. The branches of the lower jaw not united in front. Upper jaw consisting of four branches. Simple, sharp, and numerous teeth; and long, curved, tubulated fangs, in addition to these, in the venomous kinds. They creep along the ground by undulations of their body. Excepting the ophiisauri, they have no external auditory openings. Heart with a single auricle. Double penis. Eggs covered with soft calcareous shells.

4. BATRACIAN order; Frog kind. They resemble the preceding orders in having a tail; excepting the frogs and toads in their perfect state: a trachea and larynx, capable of producing sound. Like the chelonian and saurian reptiles, they have feet, and simple jaws, *i. e.* not formed of two branches, moveable on each other. In common with the saurian and ophidian orders, they possess teeth fixed in the jaws; and with the ophidian, a heart with a single auricle.

Many characters distinguish them from these three orders. Their naked skin, which is warty or tubercular, more or less moist, and nearly similar to that of the cecilæ, the last genus of the ophidian order. Softness of the bones; a sternum without ribs in the frogs and toads: rudiments of ribs and no proper sternum in the salamanders: true curved ribs surrounding the body in the proteus and firen. Four feet, or two only. They all swim; those with long hind legs and no tail leap; the tree-frogs attach themselves to leaves by the round tubercles of their toes: those with four equal limbs, or two only, crawl and swim, but do not leap. An external tympanum in the tree-frogs, frogs, and most toads; no external ears in the others. No external organ of generation in the males, nor any internal real copulation. The female lays eggs in the water, or humid earth, and the male fecundates them as they pass out; or in the ovo-viviparous species, as the land salamander, the seminal liquor of the male is absorbed by the sexual organ of the female. The ova are without shells; from them proceed small animals, called tadpoles, which undergo various changes, before reaching their perfect state. They have branchiæ in their tadpole condition, and thus approach to fishes.

Notwithstanding the obvious differences of organization in the different reptiles, as the turtle, lizard, serpent, frog, and salamander, we may remark that their structure does not deviate essentially in its general plan from that of the human subject. They have a bony vertebral column, and all the principal organs found in man, but with more or less striking modifications.

Reptiles have some relations, in their organization and habits, with other vertebral animals, particularly with fishes. This is seen in the true branchiæ of the batracian larvæ and firen; in the scales of the skin in lizards and serpents; in the polygonal horny plates of the testudines, corresponding to those of some cartilaginous fishes; in the elongated form and habits of the firen, like those of the eel-shaped fishes.

The form of the body presents great differences in the reptiles; nearly all the chelonians, saurians, and batracians have four feet; and there are only two saurians with two feet. In the chelonians, the body is orbicular, more or less convex, inclosed in a bony case, and terminated by a small tail; the toes are separate and distinct in some, palmated and fin-like in others. All the saurians have an elongated body, covered with various kinds of scales, and terminated

by a very flexible tail, often composed of articulated rings. In the very elongated form of their body, the chalcides resemble serpents, though, in other respects, they are true saurians. The skin is quite naked in all the batracians; they have four feet; some have no tail, a stout, thick body, and the hind legs longer than the front; others have the shape of a lizard, being furnished with a tail, and having feet of equal length. Lastly, serpents have a very long, cylindrical body, covered with scales, and without limbs. These variations of figure must necessarily be attended with modifications in the form and position of organs; the internal arrangements will correspond with these outward signs.

Although the animals of this class differ very considerably in outward form, as well as in the general bulk of their bodies, they agree very nearly in the essential points of their organization, and more particularly in the functions of their animal economy. We may instance the mode of taking their food; the long abstinence of which they are capable; their oviparous generation; the length of time, for which they can bear an interruption of respiration; their tenacity of life and extraordinary power of reproduction; and the low temperature of their bodies. The last points, of animal heat and reproduction, two exceedingly interesting subjects of inquiry, which have been investigated of late years with great industry, form the most striking differences between cold and warm-blooded animals; the latter alone possessing that remarkable property of maintaining in themselves a temperature considerably exceeding that of the medium in which they live, while the former are distinguished by the wonderful extent of their power of extending or reproducing injured or lost parts.

An accurate knowledge of the structure of reptiles is not only important from its subserviency to the classific arrangements of natural history, and highly interesting from exposing to us new and rich scenes in the vast domains of nature, new forms of life, and fresh modifications of organization, accompanied with singular changes of functions already familiar to us in other shapes; but it acquires additional interest from the great use which physiologists have made of different reptiles in their experimental elucidations of the human economy. We must survey in a general view the structure and economy of these animals, and compare them with those of this warm-blooded classes, before we can determine how far the conclusions, drawn from experiments on reptiles, concerning the heart's motion, irritability, the action of the nerves, the effects of opium, &c. &c. can be transferred to the human body.

Organs concerned in the Vital Functions.—The mouth is situated at the extremity of the snout, and directed transversely. If we fancy the head to be divided by a horizontal cut, extending from before backwards, to its very posterior part, we shall have a just idea of the mouth of a reptile. The cranium is very small in this class, and the head consists almost entirely of the two jaws. The lower is articulated towards the back of the head, and thus allows the opening between the two mandibles, constituting the mouth, to be very considerable. Almost all reptiles swallow entire animals, and thus require this extensive opening. The margins of the aperture consist simply of the maxillary arches, which are not covered or enclosed by any thing deserving the name of lips. In no case is there any mastication; and the food or prey is taken by the teeth or tongue, so that a moveable covering of the jaws, similar to the lips and cheeks of the mammalia, is not necessary either for confining substances subjected to the action of teeth as organs of mastication, or for the purpose of reaching or seizing food.

The horny coverings of the mandibles, completely naked, and not concealed even by the smallest fold of skin, form the sides of the entrance into the mouth in the chelonian reptiles. Their food consists of marine vegetable productions, testacea, insects, &c. and does not require so large an opening for its introduction, as when considerable animals are swallowed whole. The mouth is consequently smaller in this than in either of the other orders; and does not extend completely to the back of the head.

The family of tortoises, which Geoffroy has called *trionyx*, offers a remarkable exception to what we have stated about the absence of lips: they have these folds, and a moveable proboscis at the end of the snout. "The existence of lips in these tortoises is an anomaly, the more likely to surprise us, inasmuch as the affinity of these reptiles to birds seems to assign a motive for the absence of lips, and also for the existence of the horny coverings of the mandibles." Geoffroy St. Hilaire, *Mém. sur les Tortues molles*; *Annales du Muséum*, v. 14. pl. 1. p. 9.

In the saurians, the slit of the mouth goes to the very back of the head, far behind the ear. Its appearance is very formidable in the crocodile, where the hard strong jaws project into a large snout, and are armed with sharp powerful teeth, destitute even of gums: these jaws open to the very back of the head, and disclose a tremendous throat. The mouth is as large proportionally in the other saurians; but their size is too insignificant and their habits too harmless to allow of their inspiring that terror, which the formidable weapons of the crocodile so justly cause. The ophidians have not only a mouth equal in its transverse measurement to the diameter of their body; but they possess also the means of enlarging this aperture, so that they can swallow creatures whose diameter exceeds their own. The batracians have an opening as large as the size of the head will allow. In the latter, as well as in the ophidian, and most of the saurian reptiles, the integuments make a small fold at the edge of each jaw; these folds meet when the mouth is closed, so as to hide the edge of the jaws, but they possess no power of motion.

In the tadpole, in the proteus and firen, the mouth is much smaller than in the other reptiles; and they possess folds more deserving the name of lips. In the former there is a kind of horny apparatus within these lips, forming something like a beak. In the smallness of its mouth, and in these horny jaws, the tadpole is remarkably dissimilar to the perfect animal.

The Jaws.—In considering the jaws and their muscles, the teeth, and the tongue, we must bear in mind that these organs are calculated merely for seizing their food, and conveying it to the throat; in no case does the food undergo any mastication, as in the mammalia.

No reptiles have an upper jaw moveable on the head, like that of birds: the superior maxillary bones are in truth articulated moveably with the head in serpents, and may be extended and retracted, or moved laterally, as we shall describe presently; but, in general, the cranium and upper jaw are united into one piece, so far as their motions are concerned.

The most opposite opinions have prevailed respecting the crocodile, even down to the present time. Herodotus first observed, that it is the only animal possessing an upper jaw moveable on the lower, which remains fixed. The same opinion was generally held by the ancients, as Aristotle, Pliny, &c.; and several moderns speak in the same way, as Maregrave, Marmol, Jacobæus, Velsius, and the Jesuit Missionaries at Siam, who had opportunities of observing the living animal. But the anatomists of the Academy of Sciences

Sciences (Perrault and Duverney) undertook to demonstrate the falshood of the opinion of Herodotus. Geoffroy, one of the French savans, who attended the Egyptian army, has given us an account of the matter, which settles all these disputes, by proving that the statement of Herodotus is almost rigorously true; and that the crocodile is the only known animal, whose upper jaw, including within its branches the cranium, is moveable on the lower jaw, which possesses only an almost insensible degree of motion. "Nothing can be more paradoxical than the head of the crocodile: every thing which is placed laterally in other animals, as the moving powers of the jaw, &c. is thrown behind. The temporal bone itself extends backwards far behind the cranium, is elongated, and transformed into a double condyle. We have in fact nearly described the crocodile's head, when we say that it consists of two mandibles; for the cranium is so small, and out of place, that it escapes notice at first. We find it below, and a little in front of the occipital crista. The brain is so far forwards, that the eye and ear are above and a little behind it.

"The lower jaw is one-sixth longer than the upper, with the cranium: it presents a cavity with a double surface, in which the condyle of the temporal bone is articulated by ginglymus. The occipital condyle is in the same line as the temporal condyles: thus the head is really held at its articulations, like the lid of a box by the hinge, and is confined entirely to motions upwards and downwards. When a living or stuffed animal is examined, it is difficult to believe that the head ends at the extremities of the jaws. There is a regular fullness of the front of the neck, which might be regarded as the frontal part of the head: this arises from the enormous temporal muscles, which lie between the recti and obliqui. The latter, arising from the cervical vertebrae, and inserted in the occipital crista, elevate the head upon the neck, making it describe an arc of 45° . The skin behind the occiput being thin, yields to the motions of the head; while the lower jaw, on the contrary, is inclosed in a kind of sheath of hard, rugous skin. If there were a muscular force capable of drawing it down, this covering would impede its descent, while it is still further confined behind: the long process situated beyond its articular surface, describing a curve, approaches the skin exactly at the point where it is armed with a long scale, which offers an almost invincible resistance to the elevation of the condyle, and consequently to the depression of the jaw. Yet it is not entirely fixed, as Marmol imagined, who stated that it forms a single bone with the sternum. Two small muscles have the power of moving it slightly." (Annales du Muséum, tom. ii. p. 38, et seq.) This description is accompanied with an excellent figure of the skull, in the elevated state of the upper mandible. An analogous figure of the whole head is given by Humboldt, Recueil d'Obs. de Zool. & d'Anat. comparée, tom. i. pl. 4. From the figures of the Nilotic crocodile, in Blumenbach's Abbildungen Natur Historischer Gegenstände, N^o 26; and of the St. Domingo crocodile, in the Annales du Mus. tom. ii. it appears, that the animal most frequently exhibits this elevation of the upper jaw. It cannot be necessary to point out how the raising of the entire cranium and superior mandible, just described, differs from the motion of the upper jaw upon the cranium: this has been already done by Blumenbach. See System of Comparative Anatomy, p. 111, note 8.

The length of the lower jaw is much more considerable in comparison to that of the upper in reptiles, where it is articulated far back, and is even prolonged beyond its articulation, than in mammalia and fishes, where this articulation is placed more forwards. Its composition is more compli-

cated in the reptiles, than in any other order. In the green turtle (*testudo mydas*) it consists of seven distinct pieces, a middle one forming the arch, and three others on each side, forming a continuation of its branches. The farthest of the three penetrates like a wedge between the two others, and forms a great part of the articular cavity. In many of the saurians the number is still greater: the lower jaw of the Nilotic crocodile, and of the caiman (*croc. americanus*), has no fewer than twelve pieces, arranged as follows. As the two branches are distinct, and united by a suture, each of them must be composed of six pieces; 1, one, in which all the teeth are implanted; 2, another, lying along the internal surface of the former, without reaching to its anterior extremity; 3 and 4, two others articulated with the preceding; viz. an inferior one prolonged to the posterior extremity of each branch, a superior extending as far back as the other in the Nilotic crocodile, but not so far in the caiman. 5. The greatest part of the articular cavity is excavated in a fifth piece within the two former, and constituting the inner and superior part of the portion beyond that cavity. 6. Lastly, a sixth piece forms the front and inner part of the orifice of the dental canal. The lower jaw of the *tupinambis* (*lacerta monitor*) is also composed of twelve pieces, two of which form the coronoid processes, while the other ten are analogous to those described as entering into the formation of the lower jaw of crocodiles, excepting the last. There are eight or ten in most of the other saurians. We find four in each branch in the genus *anguis*; an anterior one united to its corresponding piece in front, and three posterior ones joined to the former. There are only four altogether in the *amphisbæna*. The two last mentioned genera are the only ophidian reptiles, in which the jaws are not separated in front. In all the others there is a separation, and each branch has only two distinct pieces; an anterior, in which the teeth are implanted, and a posterior: they are united by suture, and vary in relative length, according to the number of teeth. The very open arch, composing the lower jaw of the batracian order, is made up of six pieces; the middle of which are the most slender.

The anterior angle, formed by the union of the two branches, depends on the form of the snout in general, on the figure of the two branches, the presence or absence, number and size of the teeth, &c. It is rounded and very open in the chelonian reptiles, and more so in the batracian. In the ophidian order, which have the branches of the jaws moveable, it is susceptible of change, according as their extremities are approximated or drawn asunder; indeed in the former case only can it be properly said to exist at all. It is rounded in the *amphisbæna*; more angular in the *anguis*; still very obtuse in the geckos (*lacerta gecko*), which have wide jaws, with the branches of the lower curved only in the horizontal direction; it is less so in the *cameleon* and *stellio* (*lacerta stellio*), the *scinks* (*lacerta scincus*), and the lizards, although in all these the two branches are only joined by their extremities. It is acute in the *tupinambis* and *iguana*, in which the branches, somewhat curved in the vertical direction, are approximated for a longer space. The Nilotic and Gangetic crocodiles differ very much in this respect. The two branches are united in the latter in the greatest part of their extent, as in the *cachalot*, and consequently form a long bill, in the edges of which the two rows of teeth are implanted. In the former, on the contrary, the branches remain separate, and only approximate towards their extremity, increasing a little in thickness at the symphysis.

The portion of the bone, which is incurved towards the cranium in most of the mammalia, and constitutes the

the ascending branch of the jaw, does not exist in reptiles.

Motions of the Jaws.—Reptiles may be divided into two orders, according to the conformation of their maxillary bones, and the kind of motion of which they are susceptible. In the first would be placed those which have the lower jaw only moveable, as the lizards, the testudines (tortoise and turtle), the frogs, the salamanders, and the genera *anguis* and *amphibæna* among the serpents. The second would include the colubres, and the venomous serpents, which can move both jaws.

The general disposition of the articulation is nearly the same in reptiles as in birds (see *BIRDS*, in *Comparative Anatomy*). Instead of a condyle at the posterior extremity of the jaw, an articular surface is excavated to receive an eminence bearing considerable analogy to the *os quadratum* of birds, and differing from it only in not being so moveable; often, indeed, it is only a simple prolongation of the temporal bone. To this most inferior point of the cranium, and to an articular surface nearly transverse in its direction, and shaped like a condyle, the lower jaw is articulated by a glenoid cavity, of which the middle part sometimes presents a rising line, converting it into a kind of pulley. Behind this articular cavity there is often a more or less considerable bony process, affording attachment to a muscle analogous to the digastric.

The most remarkable differences requiring our notice here are, the form of this prominence or condyle of the temporal bone; the greater or less prolongation of the process behind the articulation; the situation and extent of the temporal fossa; and, lastly, the existence or absence of the eminence occupying the situation of the coronoid process.

In proportion as the temporal eminence is carried backwards, the jaws approach more nearly to each other in their longitudinal direction. We see this in the crocodile, salamander, frog, turtle, and tortoise. When, on the contrary, it descends vertically, or very obliquely, and is very elongated, as in the camoleon and iguana, it forms a kind of pedicle to the lower jaw, which, by separating it from the cranium, produces a much more considerable interval between the jaws. Several kinds of lizards, as the *lacerta agilis*, *draco*, &c. occupy the intermediate space between these two extremes.

The crocodile has the largest process for the attachment of the digastricus. It is sensibly diminished in the camoleon, the gecko, the tupinambis, and the testudines; and we see nothing of it in the pipa, the toad, frog, and salamander.

All four-footed reptiles have very deep temporal fossæ; they are united to the cavity of the orbit. In some species, the two cavities are separated in front by a bony circle, as in the testudines, the crocodile, the dragon, and the other lizards; but in the pipa, the frogs, and salamanders, there is no orbital circle.

There is, in the crocodile, a considerable excavation on each side of the cranium, behind the orbit, terminating below in the temporal fossa, and wanting in the crocodile with bony eyelid (*Crocod. palpebrofus*, Cuvier). It is bounded externally by a bone corresponding to the squamous portion of the temporal, which joins the lateral frontal bone, and thus forms a second kind of zygomatic arch. The size of this excavation differs much in the different species. No doubt it contains muscles. But we find no express and satisfactory description of it and its muscles, nor of the muscles of the jaw in the writings of the French naturalists already quoted, on the subject of the crocodiles.

The coronoid process of the lower jaw is not prominent in reptiles. There is a mere rudiment of it in the testudines,

the camoleon, and some lizards, as the iguana, but there is no trace of it in the crocodile, the frogs, and salamanders.

The muscles of the jaw, in the oviparous quadrupeds, are analogous to those of the mammalia, and resemble them in number.

The masseter is large and distinct in the tupinambis, occupying all the space comprised between the posterior edge of the orbit and the meatus auditorius. It is directed obliquely from behind forwards, so that it raises and carries the jaw backwards. This muscle is small in the agame marbré (*lacerta marmorata*), and the turtle. It is so slender, that it can scarcely be distinguished from the lower part of the temporal.

The temporal muscle is very large in the turtle, occupying all the temporal fossa, and forming the back of the orbit. It is much smaller in the tupinambis and common lizard, in which it is almost entirely concealed by the masseter.

The pterygoidei are, in general, but imperfectly distinguished from each other. They envelope the whole branch of the jaw towards its extremity in the tupinambis; their fibres are in a manner twisted. They elevate the jaw and carry it forwards; thus they act in an opposite direction to the two preceding muscles. The same muscles are flat and thin in the turtle; their fibres are nearly transverse, so that they can move the lower jaw more directly from side to side.

In all these reptiles the muscle analogous to the digastric is flat and triangular; the broad portion is fixed to the cervical ligament behind the occiput, and the point terminates at the extremity of the jaw, behind its articulation, and near the pterygoid muscles.

After describing the muscles employed in moving the jaws of the turtle, Perrault asserts, in his "*Mémoires sur les Animaux*," that it has more power in its jaws than most other animals, that it can cut very hard and strong substances, and that the head of a small turtle has been seen, half an hour after it was cut off, to strike its jaws together with a noise like that of castagnettes. Daudin relates the following circumstance, communicated to him by a Dutch naturalist, who resided several years in India. "When we landed in Table bay, we took several hawk's-bill turtles (*testudo imbricata*), whose stomachs were filled with marine plants, and thick shells, which they easily break down with their horny gums. Three, which could not be brought on board, were tied to the trunk of a tree, with a thick cable, but when the sailors returned on the following morning, they found that these turtles had contrived to turn over on their bellies, and had then cut, with their gums, the cables with which they had been fastened." Hist. Nat. des Réptiles, in the edition of Buffon, by Sonnini, t. i. introduction, p. 38.

The two jaws are not moveable in all the serpents. They may be divided into three orders. 1. Those with the branches of the lower jaw consolidated, and consequently not possessing any power of thrusting forward the upper jaw, or moving it laterally. 2. Those with the branches distinct, and united in the recent state by an elastic ligament. There are two modifications of the latter; they may either have merely the power of separating the two jaws; or they may, at the same time, separate the jaws, and carry forwards a part, or the whole of the upper. We shall speak of the motions of the jaws according to this division, first describing the bones, and then the muscles.

The Bones.—In the serpents, with the lower jaw consolidated, the head is shaped nearly as in the lizards. This is the case in the *anguis* and *amphibæna*, the *cæcilia*, *acorchodus*, and *hydrophis*. In the genus *anguis* the head very closely resembles that of the iguana. The arch of the upper jaw

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jaw is uninterrupted, and corresponds to the curve of the lower; the concavity of the palate is nearly complete in front. The palatine arches are directed backwards, and united to the condyloid pedicle of the temporal bone. This pedicle is short, and nearly vertical, and excavated behind for the attachment of the digastric muscle. The lower jaw has a small process behind its articulation for the attachment of the muscles, which depress it; and another towards its posterior third portion, analogous to the coronoid, for the elevating muscles.

In the amphibia, although the general configuration is a little changed, nearly the same arrangement is met with. The whole upper jaw is less separated from the cranium; the concavity of the palate is nearly complete. The palatine arches are much larger. The condyloid pedicle of the temporal bone, instead of being vertical, is continued nearly horizontally forwards. In proportion to the cranium, the lower jaw is much shorter; and it is articulated to the condyle by its posterior extremity. It is very wide behind, to produce the coronoid process. The orbit and temporal fossa are completely confounded; they are bounded by prominent bony cristæ, as in the carnivorous mammalia; hence, on first view, the head of an amphibia might be supposed to belong to one of the cheiroptera.

The serpents of the second kind, whose lower jaw is formed of two distinct branches, and in which the upper is capable of being separated, but not carried forwards, are all the non-venomous colubres, and the boas. The conformation of the upper jaw, in the latter, is very different from that of the lizards, although the bones are nearly the same, as we shall explain in the osteology of the head. The ossa incisiva are not always furnished with teeth; sometimes even, as in the boas, they do not unite the superior maxillary bones. All the other bones of the jaw are moveable on the cranium, which serves merely as a point of support.

The superior maxillary bones are two long branches, in which the teeth are implanted; they form the outer edge of the palate. They are articulated by two points; first towards their middle, as a lever of the first kind, on a small bone analogous to the os male, and forming the anterior edge of the orbit: nearly at the same point, but towards the inner side, the superior maxillary bone has a process, which slides in a groove, and rests on the palatine arch. It moves on these two surfaces, playing backwards and forwards. The anterior extremity of this upper maxillary bone is free: the posterior receives the end of a particular bone, serving to unite it to the palatine arches.

The palatine arches are the two internal bony branches themselves, formed of two parts. An anterior, which is free in front, and articulated by three points; behind, with a bony branch, which proceeds towards the extremity of the lower jaw within its articulation, and appears to form a continuation of it; on the outside, with a particular bone, uniting it to the maxillary arch; and above, with the basis of the cranium, in front of the orbits. The posterior portion of the palatine arch is analogous to the pterygoid alæ or laminae. It is articulated by three points; 1st, in front, with the posterior extremity of the first portion; 2d, behind, with the lower jaw towards the inside; 3d, on the outside, and towards its anterior part, with the bone uniting it to the maxillary arch. Lastly, the third palato-maxillary is a piece nearly cylindrical in its middle, flattened and widened at its two extremities, by which it is supported, being articulated, on the outside, to the posterior extremity of the maxillary arch, on the inside, towards the middle and outside of the pterygoid portion of the palatine arch.

In consequence of this singular formation, the whole upper jaw is, as it were, suspended and distinct from the cranium, and influenced by the motions of the lower jaw. When the posterior extremities of the latter are separated, the pterygoid arches are moved apart. They carry with them the posterior extremities of the palatine and maxillary arches, while at the same time the anterior extremity is moved inwards. On the contrary, when the two internal edges of the pterygoid laminae are brought together, or, what is the same, when the articular extremities of the lower jaw tend to approximate, the anterior ends of the palatine and maxillary arches are carried outwards, and separate from each other.

The serpents of the third order, which have jaws susceptible of separation, and which at the same time can carry forwards the superior maxillary bones, properly so called, exhibit but a slight modification of the structure described as belonging to the preceding division. Their pterygoid arches are articulated with the lower jaw, towards its extremity, on the guttural aspect. They also receive the bone which is to join them to the palatine arches; but the latter are very short, directed forwards, and only containing venomous teeth. This intermediate bone, therefore, goes above the superior maxillary, which is itself articulated in the front of the orbit, or the short and moveable cheek-bone. When the lower jaw is moved forwards, the palatine arch, carried in the same direction, drives before it the bone which joins it to the maxillary. The latter, extremely moveable, is immediately turned up, or carried forwards, by moving on the cheek-bone, which causes a complicated series of motions.

The articulation of the lower jaw is the same in the whole family. The temporal processes are prolonged posteriorly: they receive an intermediate bone; analogous to that designated by the name quadratum in birds. This bone is very short, and possesses little motion, in the species which have the upper jaw fixed, and the inferior consolidated.

It is directed forwards in the amphibia towards the lower jaw, which is shorter than the cranium by nearly one-third;—a circumstance which belongs only to this species. In the anguis, the os quadratum descends much more obliquely forwards.

In all the other species the bone last-mentioned is much longer. It sometimes descends perpendicularly, as in the boas; but it is commonly directed backwards, as in most of the colubres. The temporal extremity is generally widened and excavated by a small depression. The inferior extremity is rounded like a condyle, and received into an excavation of the posterior extremity of the corresponding branch of the inferior maxillary bone.

From the nature of its articulation, the lower jaw of either side is not only susceptible of elevation and depression, so as to open and shut the mouth, by playing on the os quadratum, as is the case only in the genera amphibia and anguis; but it may also be carried outwards, and take with it the os quadratum, as is the case in the colubres and venomous serpents, whenever the pterygoid arch is moved outwards. That is to say, whenever the upper jaw is widened, the inferior must follow its dilatation, because the posterior extremities of the pterygoid arches, being articulated with the internal part of the lower jaw, it must move together with them. The arrangement of the muscles accords very well with this formation, as we shall proceed to describe.

Muscles of the Jaws.—The maxillary muscles of the genera anguis and amphibia, and probably of all the serpents with a consolidated under jaw, resemble those of the
common

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common lizard: but they are very different in those whose lower jaw consists of two distinct pieces: we shall describe them in the rattlesnake.

Here the muscles of the lower jaw are concealed in the lips, and go round the mouth on each side. That which forms the anterior edge of the commissure of the lips is the strongest, and seems to hold the place of the masseter. It arises by firm aponeuroses from the tendinous sheath, which contains the venomous gland. Its fibres form a considerable cord, which constitutes the whole thickness of the lower lip, and are inserted in the upper edge of the inferior maxillary branch for almost two-thirds of its length.

The muscle immediately behind is analogous to the temporal, and is much slenderer than the preceding. It is a muscular fasciculus, of which the superior extremity is fixed to the temporal excavation behind the orbit, and the inferior, after going backwards behind the commissure, is confounded with the insertion of the last muscle. It is obvious that the contraction of these two muscles must approximate the jaws, and thus close the mouth.

In the commissure of the lips, and behind the two last muscles, we see another resembling them in form, but much shorter. It occupies the inferior part of the os quadratum, and about the posterior third of the jaw, at the outer edge of the dental canal. It is an accessory muscle to the temporal and masseter.

The muscle corresponding to the digastricus occupies the whole length of the back of the os quadratum, and terminates at the posterior apophysis of the maxillary branch beyond and behind its articulation.

The muscles moving the upper jaw are more numerous. One arises, by aponeurotic fibres, from the capsule of the joint, between the maxillary branch and the os quadratum, and passes forwards and upwards towards the sheath of the venomous teeth, being partly expended on that sheath, and on the posterior apophysis of the superior maxillary bone. Its use is evidently to draw down the venomous teeth, when they have been elevated.

Two other muscles act on the pterygoid and palatine branches. Both are situated between the middle line of the basis crani and the palatine arches. The lower, situated immediately under the skin in the palatine fossa, is a plane of elongated fibres, occupying the whole middle line of the cranium, and going backwards to the internal surface of the bony pterygoid plate, which it will carry inwards and forwards, so as to protrude the superior maxillary bone, and elevate the venomous fangs, at the same time contracting the mouth by the approximation of the two internal arches.

The other muscle, slenderer, and placed above the preceding, towards the basis of the skull, extends from the anterior portion of the palatine arch, and the whole length of this arch, to the middle of the basis crani, crossing the direction of the last muscle, on which it is placed. When it contracts, it carries backwards the whole mass of the upper jaw, at the same time approximating its two branches.

By means of this mechanism, serpents can twist their mouths in seizing objects, and dilate them extraordinarily, so as to swallow animals larger than themselves. Their teeth serve merely for holding their prey; and the muscles moving the bones, in which these teeth are implanted, cannot move them in such a way as would be necessary for mastication, but merely depress, elevate, approximate, separate, protract, and retract them.

Lacépède thus describes the motions of the jaws in serpents. "While the teeth of one side are fixed in the prey which the animal has seized, and are therefore motionless,

those of the other side are carried forwards, penetrate the animal, drag it towards the throat, and there fix it in their turn; when the opposite ones are again advanced to repeat the same process on their side. By these repeated alternate motions of the two sides of the jaws, combined with their lateral expansion, serpents are enabled gradually to swallow animals of a diameter exceeding their own." Hist. Nat. des Serpens.

The Teeth.—Their structure has nothing peculiar in reptiles. The bone is compact and hard; the enamel thin; and, as they are always thin, there is none of the third substance called by Cuvier the cement. We are not acquainted with any facts concerning the succession of the teeth in reptiles;—whether they have two sets, or that the first grow constantly, or that the jaws are elongated anteriorly, &c. The crocodile forms an exception to this remark: we are indebted to Cuvier for a very interesting account of the succession of their teeth, which we shall state presently.

The chelonian reptiles, like birds, have no teeth, properly so called: the horny substance encasing their jaws, and supplying the place of teeth, will be described at the end of this account of the teeth of reptiles.

The saurian, ophidian, and batracian reptiles may be compared to the cetacea; as they do not masticate their prey, the teeth are calculated merely to hold, and not to divide it: hence they have much less influence on their economy than those of viviparous quadrupeds. They accord, however, tolerably with the natural genera and subgenera.

They are almost always the same in all parts of the jaw, so that they admit of division into different classes, according to their configuration, only in very few species.

Sometimes they are attached to the two jaws only, as in the mammalia: this is the case with the saurians (excepting only the iguana, which has palatine as well as maxillary teeth); sometimes they are implanted also in the palate, as in the ophidians, with the single exception of the amphibæna. Their number is of less importance; first, because it is considerable, and not accurately determined; secondly, because they fall out without any hitherto ascertained regularity, either in situation or time.

Teeth of the Saurians.—In the crocodile the enamel is more or less striated longitudinally. The upper and lower teeth cross when the jaws are shut. They are all conical, hollow, generally a little curved, and marked with two longitudinal projecting lines; an anterior and a posterior one. The five or six posterior teeth on each side are more obtuse and compressed than the others.

In a living crocodile, which Perrault observed at Versailles in 1681, he found that all the teeth were slightly bent towards the throat, and that this curvature was the most conspicuous in those near the end of the snout. When the jaws were drawn together, the teeth of each jaw passed into the intervals between those of the other, so that an uninterrupted series was visible, as there are no lips to hide them. He says further, that the points of the upper teeth entered into excavations of the lower jaw.

The following account is derived from Cuvier's *Obs. sur l'Oséologie des Crocodiles vivans*, in the 10th volume of the *Ann. du Mus.* "The number of the teeth does not change with the age of the animal: a crocodile quitting the egg has the same number as one twenty feet long. I have ascertained this fact in a series of heads from an inch to two feet long. The back teeth may be a little concealed by the skin of the gums. The interior is always hollow, although,

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although the teeth, as in all other cases, are formed by successive strata.

"The capsule containing the new tooth is not enclosed in a separate cell of the maxillary bone, as in the mammalia, but it lies in the bottom of the socket of the tooth which it is destined to succeed. This little shell is first on the internal surface of the root of the tooth in place; it occasions a groove in this part, by which, as it increases in length, it penetrates into the hollow of the latter, and then destroys by its pressure the pulp that filled its cavity, and furnished the materials of its increase. Hence, at whatever age we may remove a crocodile's teeth, we shall find, either in the alveolus, or in the cavity of the tooth itself, a small tooth, either in the form of a thin and short shell, or more advanced and ready to occupy its place, when the old and enveloping tooth shall have been discharged. This succession seems to be repeated as long as the animal lives: hence the teeth always appear sharp and fresh, and although larger, they are not much more worn in old than in young crocodiles. I have ascertained all these facts in a recent head, and in others preserved in spirits of wine: and I could distinguish very clearly pulps and capsules similar to those of quadrupeds.

"This process was tolerably well understood by Perault and Duvernoy; *Mém. pour servir à l'Histoire des Animaux*, v. iii. p. 167.

"As the teeth of the crocodiles are generally nearly perfect cones, and enlarge to their very basis, how can they come out of the alveoli, of which the entrance is much narrower than their base? The new tooth, as it is developed and fills the cavity of the old, compresses its substance against the socket, destroys its consistency, makes it crack, and thus disposes it to be separated on the slightest shock at the level of the gum. The fragments are easily thrust out of the sockets. We often find in the sockets of crocodiles, when changing their teeth, rings formed by the relics of the old teeth left behind, through which the new are making their way: and such are also found in the fossil jaws of true crocodiles.

"The base of the cone is generally not entire, but exhibits a more or less deep fissure on its internal side: it has been already mentioned that this is caused by the pressure of the germ of the new tooth. While the germ is very small, this fissure does not exist, and the germ itself never exhibits it.

"Although the teeth may be said to be all alike, and arranged in an uniform series, some are rather larger than the rest; and the greater this inequality, the more irregular is the line of the jaws.

"These larger teeth are either received into grooves of the opposite jaw, or into holes, or they perforate it completely.

"In the caimans or alligators, the first of Cuvier's subgenera, (containing the American species,) there are from nineteen to twenty-two teeth on each side below, and nineteen or twenty above. The two first of the lower jaw penetrate at a certain age the front of the upper jaw, and go completely through it. The fourth of the same jaw are the longest, and go into the holes of the upper jaw, in which they are entirely concealed when the mouth is shut. The five front in the upper jaw are intermaxillary teeth.

"The first and fourth of the lower jaw are long in all the three subgenera; next to these come the eighth and ninth of the upper, the eleventh of the lower jaw in the true crocodiles and caimans. The caiman with bony eye-lids (*crocodilus palpebrofus*) has the twelfth below and the tenth

above the longest. After the fourth in the gavials (*longirostres*) they are all nearly equal, so that the jaws in these have not so waving a line as in the other subgenera.

"The fourth tooth below might be called canine, from its superior length, and because it corresponds to the future between the maxillary and intermaxillary portion of the upper jaw.

"In the second sub-genus, or proper crocodiles, there are fifteen teeth on each side below, and nineteen above. The first of the lower jaw penetrate the upper; the fourth pass into grooves, and are not lodged in cavities of the upper jaw.

"The gavials (*longirostres*) have 25—27 on each side below, and 27—28 above. The two first and the two fourth of the lower pass into grooves, not into perforations or cavities of the upper."

In the *tupinambis* of the Nile we find sixteen above, of which five are intermaxillary, thirteen below; all conical, and slightly bent backwards: the posterior are the largest and most obtuse. In a *tupinambis* from the Moluccas there were six above, and seven below, all compressed and pointed.

The teeth of the common lizard, the iguana, and agame, are cutting, and more or less serrated on the edges; they are all so in the iguana, where several have six or eight denticulations, and there are twenty or twenty-one teeth on each side. The common lizard has twenty-one or twenty-two, but the anterior are not sensibly denticulated, and the others have merely a groove. The agame has nineteen or twenty, all with three denticulations. In these three genera they increase in size from before backwards.

They are triangular, with a little groove before and behind, in the *stellio*: there are sixteen or seventeen such on each side, and two large conical canine teeth. There are, moreover, two small conical intermaxillary teeth above, to which nothing corresponds below.

The dragon corresponds to the *stellio* in its teeth, except that the canine are proportionally longer than the incisors: the number is the same. There is a good representation of them in Blumenbach, *Abbildungen Natur-Historischer Gegenstände*, No. 98.

The gecko has thirty-five or thirty-six teeth on each side, all of equal size, close, simple, slender, and pointed. The flat-headed gecko has seventy or seventy-four on each side. There are twenty-two on each side, above and below, in the *scink*, all conical, short, closely set, and of equal size.

The *cameleon* has, on each side, eighteen above and nineteen below; of which the anterior are very fine, the posterior much larger, and furnished with three points.

Teeth of the Batracians.—All these have teeth in the palate; as to the jaws, the salamanders have them in both, the frogs in the superior only, and the toads in neither.

The palatine teeth form, in the toads and frogs, a transverse line, interrupted in the middle. They are implanted in the palate bones. They form two long parallel lines in the salamander.

The maxillary teeth are small, pointed, and closely set. The frog has about forty on each side above, eight of which are intermaxillary; the salamander sixty, both above and below, and thirty on each side of the palate.

Teeth of the Ophidians.—The serpents are divided first into two families, those which can, and those which cannot, separate the two halves of the upper jaw. The former have no incisor teeth; but they have palatine, maxillary, and mandibular,

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mandibular, or teeth of the lower jaw. The latter, having all the edge of the upper jaw furnished with teeth, possess, consequently, a kind of incisors.

The second family includes only the angues and amphibæna. The former, besides the conical slightly curved teeth of uniform size, which they have in both jaws (eighteen or twenty above, and fifteen or sixteen below on each side), possess others, very small and short, arranged in two rows, on the posterior half of each palatine arch.

The other family is subdivided into two tribes, the venomous and the non-venomous. In the latter there are conical,

curved, and very pointed teeth, directed backwards along each maxillary, palatine, and mandibular arch; consequently there are four rows in the upper, and two in the lower jaw, all nearly longitudinal.

On the maxillary branch of the venomous serpents there are only the hollow fangs, attached to the anterior extremity only; consequently, with the exception of these fangs, there are only the two palatine rows above, and the two rows of the lower jaw below.

The following is a table of the numbers of teeth on each side in some species.

Names.	Incisor Teeth.	Maxillary.	Palatine.	Mandibular.
<i>Boa constrictor.</i>	2	18	14	
<i>Coluber molurus.</i>	0	18	24	20
<i>Coluber nasica.</i>	0	16 of which the anterior are the largest.	25 of uniform size; very small.	18 the anterior largest.
<i>Coluber natrix</i> (common snake).	0	18 the posterior largest.	28	24
<i>Rattlesnake</i> (<i>crotalus horridus</i>).	0	1 and several rudiments not fixed.	14	5 or 6
<i>Coluber haje.</i>	0	the same.	25 and a parallel row of small ones.	12—14
<i>Coluber naja.</i>	0	the same.	the same.	
<i>Anguis fragilis</i> (blindworm).				
<i>Amphisbæna fuliginosa.</i>	3 on each side, and a middle one.	5	0	8

To this table, which is derived from the *Leçons d'Anat. comp.* of Cuvier, we add a second, drawn up by Palisot Beauvois, a French naturalist, who spent many years in

America, and whose observations on serpents are inserted by Daudin in the fifth volume of his *Natural History of Reptiles*.

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Comparative Table of the Teeth of several Serpents of North America, by Palifot Beauvois.

Names of the Species.	Upper Jaw.			Lower Jaw on each Side.	Total Number of Teeth.	Food.
	External Branch.		Internal Branch on each Side.			
	Fangs on each Side.	Common Teeth on each Side.				
<i>Crotalus durissus</i> .	1	0	6	5	24	Squirrels, various birds, rats, mice.
<i>Cr. rhombifer</i> .	1	0				Hares, squirrels, birds, rats, mice.
<i>Cr. miliaris</i> .	1	0				Grafshoppers and other insects, worms.
<i>Vipera berus</i> .	1	0	10	10—12	44—48	
<i>Coluber heterodon</i> (hog-nose-snake).	0	¹³ the two lower ones three times larger.	14	12—15	80—86	Insects, worms, field-mice, shrews.
<i>Col. erythrogrammus</i> .	0	10	15—16	10—12	70—76	Birds, young turtles, frogs, salamanders, the amphibious rat.
<i>Col. constrictor</i> .	0	12	28—30	16—18	112—120	As the last; also squirrels, lizards, tree-frogs.
<i>Col. getulus</i> (chain snake).	0	8	18—20	10—12	72—80	Lizards, a serpent with red and black bands, <i>col. fulvius</i> ?
<i>Col. fasciatus</i> .	0	8	20—24	12—15	80—94	Small fishes, frogs, insects, worms.
<i>Col. fulvius</i> .		the teeth not ascertained.				Grafshoppers and other insects.
<i>Col. faurita</i> .		the same.				Tree-frogs, insects, worms.

Venomous Teeth and Gland.—We have stated that the innocent serpents have teeth along the maxillary edge of the upper jaw, and in the palate; that is, four parallel rows, two external or maxillary, two internal or palatine. The venomous kinds, instead of the maxillary rows, have the venomous fangs at the anterior end of each superior maxillary branch; and they possess the palatine rows, as well as the innocent serpents. There is no difference in the teeth of the lower jaw. The venomous fangs are much longer and thicker than the other teeth: they are conical, sharp-pointed, and perforated by a fine tube. They are moveable at the will of the animal, and can be drawn up from the jaw, or laid down at pleasure. They are contained in a kind of cavity formed in the gums, from which their point projects.

At the end of his account of Indian serpents, Ruffel has given two finely engraved plates, representing the appearances of the teeth in the venomous and innocent species. In the *coluber catenularis* (tar-tuttah), an innocent serpent, there are two marginal or maxillary rows of simple teeth, and two palatine rows. The *vipera elegans* (katukah-rekula-podah) has also two palatine, but no marginal or

maxillary rows. The teeth are furrounded by a fringed membranous covering, which almost conceals them. The points alone appear, when the membrane is not entirely depressed. At the anterior end of the maxillary bone, on each side, is a large membranous sac, wrinkled, and containing the fangs. The *vipera naja*, or spectacle snake, has the palatine teeth, and two venomous fangs, like the last; but the teeth are smaller, the fangs shorter, and the membranous sac less apparent. The *bungarum-pamah*, a species of *bungarus*, has the palatine teeth, two fangs still smaller than in the spectacle snake, and at the edge of the mouth, behind the orifice of the bag inclosing the fangs, three small teeth on each side, which may be considered as an imperfect maxillary row.

In the *vipera elegans*, the fang is fixed to a bony basis, which is attached to the superior maxillary bone: this basis is much longer in the spectacle snake, and has attached to it the three small simple teeth already mentioned.

Behind the venomous fangs in the vipers and other serpents, are other smaller fangs, said to be designed to replace the former when they are lost.

Blumenbach has given an excellent delineation of the mouths

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mouths of the *boa constrictor* and the *crotalus horridus*, in his *Abbildungen Natur-Historischer gegenstände*, No. 37, to shew the difference between the venomous and innocent kinds; an object of the greatest importance, both with regard to the fewer species of the former, and the much more numerous of the latter kind, in order to warn mankind against real danger, and preserve them from groundless terrors. "All serpents (says Blumenbach), whether venomous or not, have the double internal row of palatine teeth, and the inferior maxillary teeth, in common. But the innocent species have moreover the whole outer edge of the upper jaw furnished with teeth: in the venomous kinds, this is toothless. But the latter have, at each anterior corner of the mouth, attached to the upper jaw, the long hollow fangs with a slit at their point. These are connected with the venomous glands, of which they may be regarded as bony excretory ducts, to convey venom into the wound made by the bite.

"When, therefore, we see in any snake four rows of teeth in the upper jaw, *viz.* besides the two internal palatine rows, an external row on each side running to the corner of the mouth; we may be sure that the species is poisonous, and so far innocent."

The *poisonous gland*, peculiar to the serpents with fangs, and said to be of the conglomerate kind, like the salivary glands of the mammalia, is situated on each side, behind the orbit, close to the branch of the superior maxilla, and almost immediately under the skin. It is covered by a membranous or aponeurotic semitransparent sheath, fixed to the bones of the head in front of the gland. The excretory duct extends from the anterior part of the gland, immediately under the orbit, to the bony basis of the fang, and opens into a canal excavated in the fang, running through it from above downwards, and terminating by an oblique aperture on its anterior surface. Two muscles destined to elevate the fangs, to depress the superior maxillary bones, and consequently to close the mouth, pass along these bones from before backwards; one on the outer, and the other on the inferior side of the gland. These cannot act without compressing the gland, and expelling its secretion into the excretory duct. See a representation of the gland and the surrounding muscles in the *coluber naja*, Phil. Transf. 1804, pt. 2. pl. 8.

In the article *Poison* of this work, there is an account of the appearance and sensible properties of the fluid secreted by the venomous gland of the viper, and of its effects on animals. We have a few additional points to mention on this subject, as well as concerning the poisonous properties of some other serpents.

Fontana asserts, that the noxious qualities of the secretion are retained for a long time, even in a dry state; and that persons have suffered from wounds inflicted by the fangs of vipers, and other venomous serpents, preserved in spirits or dried, even years after the death of the animal. The venom retains its colour and transparency in the dead tooth, and is still active enough to kill animals, if it be rendered fluid by immersion in warm water. He also found it active after many months, when dried and powdered.

Leeches, snails, and slugs, were not injured by the venom of the viper. The blindworm and common snake were not affected. Of tortoises, some were insensible to the bite, others died at the end of some hours, when bitten by several vipers.

The bites of the vipers of these climates produce more or less alarming symptoms in the human subject, but are not attended with danger. A peasant, bitten by a viper in the little toe, had the foot, leg, and thigh swollen in six hours; the pulse small and intermittent; there was head-ache, pain in

the abdomen, lassitude, and oppression; he cried frequently and had no appetite. He gradually recovered in two days, under the use of vegetable decoctions and poultices, which probably did not contribute much to his restoration. Daudin, Hist. Nat. des Reptiles, 8vo. introd. p. 138.

Lepéchin mentions the circumstance of a young *Baskhir*, ten years old, being bitten by a black viper (*coluber preller*, L.) in the foot. "Son pied enfla extrêmement en moins d'une demi-heure, et il éprouvoit tant de douleur dans la partie blessée, qu'il ne pouvoit pas remuer le pied sans être forcé de crier: la paleur extrême de son visage, ses yeux troublés, et sa respiration gênée, annonçoient très-fortement le danger que couroit ce jeune homme, si l'on n'y apportoit un prompt remède." Olive oil externally, and volatile alkali by the mouth, were the successful remedies. Daudin, v. 6. p. 168; (quoted from Lepéchin, Tagebuch einer Reise, &c. t. 2. p. 105).

While Charas was engaged in researches for his work on the viper, he was bitten in the fore-finger. He immediately sucked the wound, made a ligature on the root of the finger, and another on the wrist. The bite gave him but little pain. He took some sudorifics, which operated in a few hours, and he was cured.

Boyle says that he cured a man bitten by a viper, by holding a red-hot iron near the wound for a quarter of an hour. The truth seems to be, that the effects of the bite are not considerable in the human subject; and this accounts better for the recovery of persons bitten, than any virtues in the remedies employed.

The wounds inflicted by these animals are not, however, always so free from danger. The viper *cheriea* (*coluber cheriea*, L.), says Daudin, is very venomous, and its bite is often mortal. Linnæus employed olive oil in the case of a woman who had been bitten; but she died, although the remedy had been successfully employed in the bite of the black viper (*vipera preller*). Daudin, v. 6. p. 148.

The wounds of many Indian, African, and American serpents, are, however, fatal to the human subject. The *vipera cornuta* of southern Africa, is described by Paterfon as very virulent, inasmuch, that the Bosjesmen and Namaquaws employ its venom for poisoning their arrows. Daudin, *ibid.* p. 189.

A captain Hall made some experiments on the poisonous powers of the rattlesnake, of which he has recorded the results in the *Philosophical Transactions*. The first dog bitten by this animal died in fifteen seconds; the second at the end of two hours; and the third of three hours. He recommenced his experiments with the same serpent on the following day: the first dog died in thirty seconds; another in four minutes. Three days after, a frog died in two minutes, a chicken in three minutes. A little time after, an *amphibæna* was bitten, and died in eight minutes; and the serpent, having subsequently bitten himself, died in twelve minutes.

Sir Everard Hume has described at full length the case of a man, who was bitten on the thumb and fore-finger by a rattlesnake between four and five feet long in this country. He died eighteen days after the accident. Great swelling of the whole limb up to the axilla ensued; the tumefaction did not extend to the neck, but there was a fullness down the side, and blood was extravasated as low as the loins, producing a mottled appearance. A full trial was given to the volatile alkali, both externally and internally, and to other medicines of the like nature, as ether, brandy, &c. also to opium. The cellular substance had sloughed over the whole swelled part of the limb, so that the skin was separated universally from the muscles. For a further account of this case, and

and of some other cases of bites of East and West Indian serpents, see the Phil. Trans. for 1810, p. 75.

Russel, in his account of Indian serpents, has furnished us with the most ample and interesting details concerning the Indian poisonous serpents. Of these the cobra de capello, or spectacle snake (*coluber naja*), and the katuka-rekula-poda (*vipera elegans*), are the most dangerous. It appears, from a comparison of the effects of the venom of the Indian serpents, the rattlesnakes, and the viper in the mammalia, that the symptoms are nearly the same in all, but that the term of their duration differs. The bite of a rattlesnake destroyed a dog in England in two minutes; while that of the most venomous Indian snake has never been fatal to this animal in less than thirty-seven minutes. A chicken bitten by the gedi paragooodoo (*bungarus cœruleus*) was immediately affected with stupor; in ten minutes, it was incapable of remaining upright; a quarter of an hour after it was stretched on the ground, as if asleep; it made some efforts to rise, turning the head to one side and the other, became convulsed, and perished in half an hour.

A stout dog was bitten in the thigh by a serpent of the same species: he howled much from the bite, but walked about freely. He lay down in a quarter of an hour, and howled: when an attempt was made to make him stand by raising him up, it was found that the hind limbs were paralyzed. He grew worse, ceased to howl, and vomited abundantly: he became benumbed, and remained lying on the side. He died in two hours, having had very bad convulsions.

A lean bitch, having been bitten near the groin, remained fifteen minutes without exhibiting any symptoms of suffering. In fifty minutes she lay down, and appeared much affected: on attempting to make her stand, it was discovered that the limbs were paralyzed. She vomited a little, and was convulsed till death, which occurred seventy minutes after the bite.

Wounds inflicted by the spectacle snake, or *coluber naja*, had the same effects; also those of the katuka rekula-poda. Death did not always follow in the latter case, particularly in a dog, who was bitten six times, and once inoculated with the poison. A horse was bitten by the last-mentioned snake on each side of the nose. Prodigious swelling ensued, and extended to the throat; the animal refused his food, vomited, and appeared greatly affected. He had an emollient fomentation, and recovered on the third day.

Experiments with the bodrou pan had the same results: swelling, numbness, paralysis, convulsions, and death.

Russel tried inoculation of the venom with needles, thread, &c. Of six trials on dogs, none proved mortal. Eight out of twenty-four were fatal in chickens and pigeons.

Several venomous and innocent serpents were exposed to the spectacle snake: it would not bite them until incited to do it, and they died without attempting to retaliate. But Russel found, in repeated trials, that two of these animals did not hurt each other; they would fight, and wound each other, but these wounds were not mortal.

Many circumstances modify the results of wounds inflicted by venomous serpents: viz. the quantity of venom, the condition of the serpent as to vigour or weakness, the number of bites he has inflicted, the situation and nature of the part bitten, the size of the animal, &c.

There are many facts to prove, that the secretion of the venomous gland, which is so active a poison, when introduced into a fresh wound, is quite innocent, and probably inoperative, if taken into the stomach. The psylli, or serpent charmers, so celebrated among the ancients for curing persons who had been bitten by vipers, sucked the wound

strongly and repeatedly. Recent wounds made by the fer de lance (*vipera lanceolata*) of Martinique, the venom of which is very active, are also sucked with impunity. Fontana swallowed the poison of the viper, both mixed with water, and pure; it had even a mild taste, instead of producing a caustic and burning sensation, as some have stated. The heads of vipers, with their fangs and glands entire, have been eaten by dogs without any ill effects; and even the head of the terrible rattlesnake, with all its venomous apparatus, has been employed, with the rest of the body, in making soup, which has been drunk with perfect impunity.

Having thus described the instruments with which nature has furnished the venomous serpents, for the purpose of attacking, killing, seizing, and swallowing their prey, we cannot be at much loss to understand how these objects are effected; yet the prevailing notions on the subject are calculated, instead of elucidating, to involve a plain matter in obscurity and mystery. These will be most effectually dispelled by the following statement of Palisot Beauvois, who had considerable opportunities of observing the habits of serpents in America. "Much has been written on the manner in which serpents seize their prey: some ascribe to them a kind of magical power, the effect of which is to charm and enchant the animals on whom they fix their looks; others, less fond of the marvellous, pretend that they inspire them with excessive alarm, that, not knowing what they do, they run from one side to the other, fly, return, and at last precipitate themselves into the jaws of the monster; a third opinion is, that serpents diffuse around a fetid odour, by the aid of which they suffocate birds, squirrels, rabbits, and the different animals on which they feed. It must be difficult to determine the means employed by these animals in a state of nature, for the purpose of seizing their prey; and it would probably be wrong if we were to suppose that the same means are adopted in all instances. Can we believe, for example, that the black serpent (*coluber constrictor*), which creeps with astonishing quickness, climbing shrubs, and not at all venomous, should employ the same means as the boiquira (*crotalus durissus*), a slow moving animal, never ascending the smallest plant, and furnished, like all the venomous serpents, with two fangs, the wound of which is so quickly fatal? Yet, if we may judge of these reptiles in a state of liberty, by what goes on when they are prisoners, they certainly create only a common alarm, such as any creature will feel, when endeavouring to escape from its enemy. The animals experience no enchantment, nor any attack of madness, when a serpent fixes his eyes on them. Serpents produce no bad smell, still less a fetid vapour, capable of suffocating animals. The boiquira eats indiscriminately all the dead birds brought to it. It will not eat frogs, which the black serpent, on the contrary, seems to prize highly. Fascination and charms are repugnant to reason: forcerers and magicians exist no more among animals than men: cunning, address, and force, are in both cases a sufficient, as well as the only charm and power, to render the weak tributary and victim to the strong.

"I made, in conjunction with Peale, the following observations on a boiquira, which he had preserved alive for five years, and on a black serpent.

"A living bird (*icterus phœniceus*) was put into the cage with the rattlesnake, and remained there two days, without any offensive proceeding on the part of the serpent. The bird did not seem at all uneasy. As far as we could judge from the countenance, the air which it breathed was the same as it would be in an ordinary closed cage. During the two days, the reptile ate a dead bird of the same species

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as that in the cage, which he never offered to touch. Another living bird, the *loxia cardinalis*, instead of being frightened by finding himself in company with the *boiquira*, amused himself with pecking at the cage, and eating millet-seed thrown into him; he changed his situation frequently, and would even perch on the reptile's back; but he moved off at the sound of the rattle. Several kinds of frogs, living and dead, were presented to the same serpent; but he touched none. The black serpent, on the contrary (*coluber constrictor*), attacked the frogs immediately, and seemed to prefer the tree-frogs. He also swallowed flies and other insects.

"A common rat was put into the cage with the *boiquira*, who immediately appeared animated; the rat, frightened, ran towards the side opposite to the reptile. The chase lasted a few seconds, the animal using every effort to escape, when the reptile, perceiving a favourable moment, flew at his prey, and bit it. The rat continued to run round the cage, but the serpent remained quiet: the former, in about a minute, swelled, became convulsed, died, and was swallowed by his enemy. These convulsions were probably considered by old observers as the effect of the charming power of the serpent, or of extraordinary fear; but they are a regular symptom of the action of the poison.

"Perhaps these experiments do not determine exactly the means which serpents employ for seizing their prey, so likely to escape them by running or flying: but they seem sufficient to authorize us in rejecting all ideas of fascination, or charm, of extraordinary terror or suffocating vapour. On the latter point, I can state, that nine *boiquiras* were kept for three weeks in the same box; when it was opened, at the end of this time, no particular odour was observed." Daudin's *Hist. Nat. des Reptiles*, in the edition of Buffon, by Sonnini, v. 5. p. 55. et seq.

Those serpents which have not this quick and effectual means of destroying their prey by the poisonous apparatus, accomplish their object in another manner. They throw themselves on the animal which they attack, twine round his body and limbs, and exert, in this manner, a compressive force capable of breaking the bones. When he is thus disabled from resistance, they smear him over with a mucous saliva, and swallow him gradually in the way already described. The enormous serpents of Africa and America, thirty or forty feet long, are strong enough to attack and overcome the larger animals, and can then swallow them entire. See the account of the *boa aboma* by Stedman, in his voyage to Surinam and Guiana; and of the *boa constrictor*, in Adanson's *Voyage au Senegal*, p. 152. et seq.

Proportion of the venomous to the harmless Serpents.—The number of serpents possessing venomous fangs is more considerable than has been generally supposed. "Ne telis horrentibus," says Linnæus, "execrabili veneno nimium favirent, decimam quamque tantum speciem armavit imperans, et veripelles eos voluit, ut dubii omnes metuerentur ab omnibus." Yet Dr. Ruffel found seven venomous species among forty-three, which he observed; and the proportion of the venomous to the non-venomous kinds, among the serpents described by Daudin, in his *History of Reptiles*, is as 80 to 233. There are not more than 14 or 16 genera of serpents indigenous in Europe, yet among these are five vipers. Of the species described by Daudin, 201 belonged to the ancient, and 112 to the new continent: the venomous kinds formed a fourth in the former, and a fifth in the latter.

Daudin gives the following lists of the poisonous and harmless kinds.

Genera with poisonous fangs.

1. *Bungarus*.
2. *Acanthurus*?
3. *Crotalus*.
4. *Scytale*.
5. *Lachesis*.
6. *Cenchris*.
7. *Vipera*.
8. *Platurus*.
9. *Langaha*.
10. *Clothonia*.
11. *Hydrophis*.

Genera without poisonous fangs.

1. *Boa*.
2. *Python*.
3. *Corallus*.
4. *Hurriah*.
5. *Coluber*.
6. *Enhydus*.
7. *Erpeton*.
8. *Eryx*.
9. *Anguis*.
10. *Ophisaurus*.
11. *Pelamides*.
12. *Acrochordus*.
13. *Amphibæna*.
14. *Cæcilia*.

See his *Hist. Nat. des Reptiles*, v. 5. p. 22.

The following is given by Humboldt as a comparative enumeration of the venomous species in the old world, and in America.

In the old continent.		In the new continent.	
	Species.		Species.
Bungari	- 2	Bungarus	- 0
Crotalus	- 0	Crotali	- 7
Scytale	- 3	Scytalæ	- 2
Lachesis	- 0	Lacheses	- 2
Cenchris	- 0	Cenchris	- 1
Viperæ	- 44	Viperæ	- 10
Platuri	- 2	Platurus	- 0
Clothonia	- 1	Clothonia	- 0
Langaha	- 1	Langaha	- 0
Hydrophes	- 5	Hydrophis	- 0
	58		22

See the *Recueil d'Observations de Zoologie et d'Anatomie comparée*, v. 2. p. 5.

Horny Covering of the Jaws in the Chelonian Order.—This substance is similar in its nature to that which composes the hollow horns of animals (see *HORN*); and there is no essential difference between it and that of the bill in birds. (See *BIRDS*, in *Comparative Anatomy*.) As in birds, this horny covering is spread over the opposed surfaces of the two mandibles; but the organ so covered is much less susceptible of motion in the testudines, as the upper mandible is always fixed in them. In general it is sensibly fibrous in its texture, but sometimes it appears homogeneous. It is very hard, so as to enable these animals to break shells with facility. In this respect, it is analogous to the horny bills of the birds of prey, and the resemblance is so striking in one species of turtle, that it has received the name of hawk's-bill. It is formed on a vascular substance covering the bone, as is the case with the hollow horns and the bill of birds. The edges are sometimes simple, sometimes serrated, sometimes divided into large unequal teeth; the extremity is either entire and rounded, or grooved, or brought to a sharp point. The edge of the upper jaw is terminated by a thin sharp plate of horn, within which the lower passes to some height, being rather narrower in its transverse measurement: hence any substance may be cut by them as with scissars, for the outer margin of the lower jaw is also brought to a sharp edge. Besides this sharp edge, there is a covering of some breadth in the upper jaw, forming a ridge

a ridge towards the anterior part, received into a corresponding concavity of the lower jaw.

Salivary Glands.—We have already observed, that nothing deserving the name of mastication takes place in any reptile. They live on other animals, and almost universally swallow them whole. Some testudines feed on shell-fish, and break the testaceous coverings with their horny mandibles, but they do not *chew* the contained animals. The salivary apparatus must, therefore, be very different from that of the mammalia.

Several reptiles, however, require the assistance of fluids poured into the mouth for seizing and swallowing their prey. Some, as the frog andameleon, dart out the tongue, covered with a viscid matter, upon insects, which are entangled in the slime, and thus captured. Serpents spread a frothy slaver over the animals which they swallow, to facilitate their passage.

In some reptiles the tongue is composed, in great part, of a thick glandular mass, formed of numerous small tubes united at their bases, and separating towards the surface of the tongue. They are so many papillæ, giving a bristly appearance to the organ, or rendering it villous, when they are very small. The sides of the mass are perforated by numerous pores, through which the secreted fluid escapes. This gland rests on the muscles of the tongue, and follows the motions, which they communicate to the organ. The gland in question exists in the chelonians; in the testudo græca the structure just described is very evident. It exists also in several saurians, as the flat-headed gecko (*G. fimbriatus*), the common iguana, and the Schneiderian scink.

In the agame umbra (*iguana umbra*, Linn.) the gland is surmounted in front, instead of papillæ, with transverse plates closely arranged. These laminae cover the whole surface in theameleon.

The tongue seems to be covered by an analogous glandular substance in the batracians.

Where the tongue is scaly, or smooth, and covered with a simple membrane, the place of this gland is supplied by two others, elongated and glandular, situated under the skin, along the external surface of the branches of the lower jaw-bone, and pouring out their fluid at the outside of the teeth of the same jaw. In this direction they are in contact with the palatine membrane. These glands are strongly marked in the tupinambes, the colubres, and the boas. In the amphibienæ the glands are not situated in the same place, although they have the same apparent structure. They lie immediately under the tongue, between the genio-glossi and genio-hyoidei.

The conglomerate gland secreting the poisonous fluid of the venomous serpents is spoken of in the description of the teeth.

The *os hyoides* varies in the different orders of reptiles, but it approximates in general very nearly to that of birds, from which it does not differ essentially in the saurian and ophidian orders. As in birds, its connections with the larynx are very inconsiderable: there is no muscle passing between them: a simple membrane is the medium of union. They are, in fact, completely separated in some genera of saurians; as, for example, theameleon: and the same observation may be extended to all the ophidians which have a tongue included in a sheath. This circumstance completes the proof of what is rendered very probable by many other reasons, that the essential function of the *os hyoides* is to support the tongue, and assist its motions.

The form of the *os hyoides* varies much in the chelonians: sometimes the body is nearly square, thin, and flattened, then the posterior cornua are straight, articulated to

the posterior angles of the body, separating from each other as they pass backwards, and having the larynx placed in their interval. The anterior cornua are consolidated to the body, a little behind the anterior angles, directed backwards, and curved upwards behind the occiput. In front the body is prolonged into a point, under the tongue, which it supports. Such an *os hyoides* is seen in the testudo græca. But in the matamata (testudo fimbriata, Gmel.) the body is very solid, bony, and pyramidal, with the basis turned forwards. The anterior cornua, forming angles towards the front, are articulated behind each angle terminating the basis; while the posterior, more slender, and bent like an arc, are fixed near each other to the apex of the pyramid.

Usually the *os hyoides* consists merely of cartilage in the saurians, as in most other reptiles; its parts are generally slender, elongated, and consolidated with each other. Yet it preserves in the crocodile that flattened shield-like figure, which we have described it to possess in the chelonian order, and which we shall discover also in the batracians. There are only two cornua, articulated nearly in the middle of the sides of the cartilaginous plate. They seem formed of two portions united together, but distinguished by a kind of angle projecting posteriorly.

In the common iguana (*I. delicatissima*, lacerta iguana, Linn.) the body may be considered merely as the point of union of the seven cornua composing the *os hyoides*. An anterior one is continued under the tongue, without being fixed to it. The six others are behind. The two lowest are the longest; they are contiguous, slightly curved, and enter the goitre, without affording attachment to any muscles or ligaments. The four others are true cornua of the hyoid cartilage. Two pass first forwards, but quickly bend backwards, and then upwards, to reach the occiput. The others are bent backwards and upwards, so as to remain nearly parallel to these. They are analogous, in their form and use, to the corresponding parts in birds. The cornua belonging to the goitre are found also in the scinks, agames, and dragons. In the dragon rayé (*draco lineatus*) their extremity is attached to the large bag forming the goitre, and will draw it inwards, when the tongue passes out of the mouth. These cornua are not found in the other saurians. Sometimes there are only two hyoideal cornua, as in the gecko fimbriatus. They are always perfectly analogous to those of birds.

The *os hyoides* of theameleon has four; of which two are straight and directed obliquely forwards. The two posterior go behind the head. The body is prolonged to nearly the anterior third of the tongue, when that organ is in the state of repose: it is cylindrical and slender in the whole of this part, which is between one and two inches long.

In the lizards and tupinambes, the number of cornua is also four. The anterior are formed of two pieces, consolidated, or moveable on each other, of which the first is directed forwards, while the second turns backwards, and is curved towards the occiput.

In the ophidians, with a tongue inclosed in a sheath, the hyoid cartilage is composed of two parallel threads, directed from before backwards, approximated to each other, separated in their anterior half by the sheath of the tongue, and in the rest of their extent by the two hyoglossi. The two threads are united in front, nearly between the posterior extremities of the branches of the jaw, being bent into a femicircle under the sheath of the tongue; from the convexity of their union a short point is continued under the sheath. In the other ophidians, as the amphibienæ, &c. the

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the hyoideal cartilage has a triangular figure: the two posterior angles are elongated to form the cornua.

The os hyoides forms a broad nearly square plate, immediately applied to the inferior parietes of the palate and back of the mouth, in all the batracians, except the salamanders. The anterior cornua go off towards the front from the anterior angles, separate more widely before they turn backwards, then are continued towards the angle of the jaw, and curved from below upwards, in front of this angle, to be fixed to the posterior part of the cranium. The posterior horns are straight, strong, bony, not consolidated with the square plate, but articulated to its posterior angles, and directed obliquely backwards and outwards. The larynx is placed between them. The hyoid cartilage of the salamanders has a triangular form: the cornua go off from the posterior angles, and ascend at the sides of the neck. Their posterior edge is consolidated to a thread of the same nature, bent in the form of a handle, and having its anterior extremity united to that of the opposite thread in the middle of the posterior concavity of the hyoid cartilage. On each side of the branches of this cartilage, towards the front, there is a broad cartilaginous plate, nearly parallel to them, and only joined by muscles which go from one to the other. It seems to hold the place of an anterior horn.

In the thirty-fourth plate of the fifth volume of the *Leçons d'Anat. comparée*, there are figures of the os hyoides of the iguana, the Nilotic crocodile, the Nilotic tupinambis, the *lacerta agilis*, the gecko *fimbriatus*, *amphibæna*, another serpent, the *testudo græca*, the salamander and frog.

Muscles of the Os Hyoides.—In those saurians, which have a more or less protracile tongue, these muscles contribute greatly to its elongation, by carrying the bone forwards.

We find in reptiles; 1st, a muscle analogous to the mylo-hyoideus. It is composed, in the two first orders, of several portions; viz. an intermaxillary, fixed to the lower edge and internal surface of the branches of the lower jaw; a second very thick, ascending behind each angle of the jaw, upon the digastricus, and attached to the occiput; a third passing to different distances in the neck, fixed to the skin above, and embracing the neck like a girth. It is analogous to the cutaneous colli; and embraces the whole extent of the neck in the chelonians. In the common iguana the intermaxillary portion does not extend to the arch of the chin; and in the gecko there is only a thin aponeurosis reaching so far. But, in general, the mylo-hyoideus is fixed to the os hyoides in these two orders, which is not the case in the batracians; in which the muscle seems to exist merely for the purpose of filling the wide interval between the maxillary branches, and supporting and elevating the parts above it. Its fibres are directed transversely from one branch to the other; they are divided in several species by a median line, and attached to the internal surface of the maxillary branches, which enables them to elevate more advantageously the subjacent parts. In the *rana ocellata* the posterior edge is separated on each side, to ascend within the angle of the lower jaw as high as the palatine membrane.

2. The muscle analogous to the sterno-hyoideus is attached in the chelonians, between the two cornua of the same side, and to the posterior cornu; it descends along the neck, passes within the first bone of the shoulder, and is inserted on the inside of the neck of the second bone. It rests, in this course, against the sides of the œsophagus, and is strongly attached to the pharynx towards its anterior extremity.

The same muscle, in the saurians, is attached on the outside of the sternum, between the sterno-mastoidei, and is fixed to the posterior cornu of the hyoid cartilage. In the

iguana, it is fixed to nearly the whole posterior edge of the first part of these cornua; in the gecko *fimbriatus*, to the middle of this edge. In the caïman, after touching the os hyoides, it is continued to the lower jaw, and inserted far back in its lower edge.

It is much elongated in the cameleon, and carried far backwards on the outside of the sternum, forming a point in the same direction. This muscle covers another, thinner and broader, but of the same length, equally contiguous to its fellow of the opposite side in the two posterior thirds, and inserted in the extremity of the posterior cornua of the os hyoides. It might be named sterno-ceratoïdeus. In the agame umbra (*iguana umbra*, Linn.), the same muscle extends equally backwards on the outside of the sternum. The sterno-hyoideus has two portions in the crocodiles, which are only separated beyond the sternum: the lower one is thinnest, and inserted in the edge of the hyoid plate; the outer, broader and thicker, reaches the posterior edge of the cornu, and after a slight tendinous intersection, which serves to attach it to this cornu, is continued in the same direction to the jaw, and forms the first layer of the cerato-maxillary muscle.

In the serpents, the place of the sterno-hyoideus is supplied by a costo-maxillary muscle, extending from the anterior ribs to the lower jaw. Its internal fibres go from the jaw and the ribs to the hyoid cartilage.

It is prolonged, in the batracians, except the salamanders, within the sternum, to the farthest end of this bone, where it is fixed; or it only reaches the middle of the sternum. Many of its fibres are expanded on the pleura. In front it is divided into several portions, inserted successively in the external edge of the hyoid plate. One of these goes as far as the anterior cornua, and is fixed to it by a slender tendon. In the salamanders, the sterno-hyoideus is continuous with the rectus abdominis, and partakes in its motions.

3. The omo-hyoideus does not exist in the ophidians.

In the chelonians it ends in the sheath of the mylo-hoideus, which incloses the extremities of the anterior cornua of the os hyoides. This muscle is very considerable in some saurians. In the gecko, for example, it is widened, to be inserted in the greatest part of the posterior cornua: it covers the greatest part of the sterno-hyoideus in front.

In the iguana it is contiguous to a muscle, which has the same direction: it is attached to the clavicle behind, and above the body of the hyoid cartilage in front. In the caïman it is also composed of two portions. The external, which is soon detached from the following, is fixed to the palatine membrane near the lower jaw. The internal is attached to the angle of the hyoideal cornu.

It is long and slender in the cameleon; it passes on the outside of the sterno-ceratoïdeus, and is fixed to the body of the os hyoides, on the outside of the sterno-hyoideus.

The omo-hyoideus of the frog is mentioned in the account of the muscles of the shoulder.

4. Muscle analogous to the stylo-hyoideus. This has only been noticed in the frogs and toads. It comes from the back of the head, behind the ear, where it is attached at the side of a muscle analogous to the sterno-mastoïdeus. It is divided into two portions in the *rana ocellata*, and into three in the common frog: they are all attached to the posterior cornu.

5. The genio-hyoideus. The chelonians have only one, the tendon of which is fixed to the arch of the chin: the two fleshy portions separate as they go backwards, and are fixed to the basis of the posterior hyoideal cornua. In several saurians the structure is nearly the same; as in the common iguana, and the caïman, for example. It consists of two portions

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portions in the cameleon; an internal long and slender one, inserted in the body of the os hyoides; an external broader and stronger, contiguous to the former, and attached to the posterior cornua in their whole length: it has an attachment also to the anterior cornua.

In the ophidians the genio-hyoidei are continuous behind with the costo-hyoidei. They are only observed in those whose tongue is not inclosed in a sheath.

The genio-hyoidei are divided behind into two portions, in the batracians. The external and shortest is inserted on the side of the hyoideal plate above its edge; the internal is prolonged on the posterior cornua, and furnishes a sheath to the hyoglossus. The sterno-hyoideus penetrates between these two portions, to be fixed to the plate.

6. The cerato-maxillary muscles. These are analogous in their attachments and use to the conical muscles of the os hyoides in birds: they only differ from them in not being turned round the cornua. They are found in the three first orders, but do not exist in the batracians. They arise from the posterior third of the internal surface of the branches of the lower jaw, and proceed backwards and inwards to the posterior cornua of the os hyoides. There are two on each side, attached to the four cornua, in the iguana. This animal has, moreover, a transverse muscle of the cornua, the fibres of which go obliquely outwards from the anterior to the posterior cornu of the same side.

In the agame umbra the last muscle is long and slender, continued from the extremity of the posterior cornu to the angle of the anterior.

In the chelonians, the cerato-maxillary are inserted into the extremities of the anterior cornua.

The tongue varies considerably in this class of animals: it is employed, in many instances, as the means of procuring their food, by those reptiles which feed on insects. But as none of this class masticate their aliment, or swallow it like the mammalia, the form of the organ is very different from that which it exhibits in the mammiferous animals.

The chelonians have a small pyramidal tongue, with the basis turned backwards, the apex forwards.

A large part of the saurians and ophidians have a tongue capable of considerable elongation. The most remarkable example occurs in the cameleon, where it is not larger than a quill, but five or six inches long: it is expanded at its extremity, which is covered with a viscous secretion. This weapon lies commonly in a sheath at the bottom of the mouth, contracted to the length of about an inch, or less. The animal can dart it out at pleasure, when the viscous fluid at its end entangles the prey, which is taken into the mouth with great celerity. "Quand les caméléons veulent manger," says Belon, "ils tirent leur langue, quasi d'un demipied, ronde comme la langue d'un oiseau nommé pic-vêrd, semblable à un verre de terre; et à l'extrémité d'icelle ont un gros nœud spongieux, tenant comme glu, duquel ils attachent les insectes, savoir est fauterelles, chenilles & mouches, et les attirent en la gueule. Ils poussent hors leur langue, la dardant de roideur aussi vitement qu'un arbalète ou un arc fait le trait." Pierre Belon, Observations, &c. liv. ii. ch. 34.

In the common lizards, the tupinambes, &c. the tongue is smooth, extensile, and terminated by two long flexible points, although semi-cartilaginous and nearly horny: it resembles perfectly that of the ophidians, excepting the anguis and amphisbæna, and perhaps also the cælia, which have it flat, and merely forked at the end, without the power of elongating it.

In most of the serpents, the tongue, when contracted, is contained almost entirely in a membranous sheath. The

mechanism belonging to these projectile tongues partakes both of that which is found in some mammalia, as the cœlidna and the ant-eaters, and of that of birds. (See MAMMALIA and BIRDS, in *Comparative Anatomy*.) It depends on muscles acting on the os hyoides, and also on the muscles of the tongue.

The stellios and ignanas have a fleshy tongue, villous on its surface, and possessing about the same mobility as that of the mammalia. In the scinks and geckos it differs from the former only in being fissured at the end; and it resembles, in this respect, that of the angues, between which and the scinks there is in all points much analogy.

The tongue of the batracians is not only different from that of other reptiles, but also from that of other animals. It is fleshy, of a flattened figure, smooth, and covered, in all of the frog and toad kind, with a tenacious mucus. It is villous in the salamanders, and covered with very long papillæ in the horned frog (*bufo cornutus*, *rana cornuta*, Linn.). The great peculiarity of the tongue is its being attached by the basis to the front of the mouth, to the symphysis of the lower jaw. This is its thickest part: it is continued backwards in a thinner form, so as to end in two loose and flat portions, representing the apex, and lying in the back of the mouth. This loose part, ordinarily turned back towards the throat, is projected from the mouth, covered by its viscous secretion, upon the small insects which the animal feeds on, and which are thus entangled and swallowed.

Muscles of the Tongue.—They possess nothing peculiar in the chelonian reptiles, which have not an extensile tongue: they consist merely of two pairs. The hyoglossi come from the anterior half of the posterior cornua, and penetrate into the tongue at the sides of the basis.

The genio-glossi are very strong and broad in the vertical direction: they come from the front of the lower jaw, and enter the tongue more outwards and forwards than the preceding, with which their fibres are interwoven. The apex of the hyoid cartilage penetrates between them: they are also separated by a small cylindrical cartilage, to which each muscle is fixed; which is prolonged behind under the body of the hyoid cartilage, extending in front to the apex of the tongue.

The saurians have in general three pairs of muscles going to the tongue from the os hyoides or the arch of the chin, and a proper muscle attached to the organ only.

1. The hyoglossus comes from the cornua of the hyoid cartilage. In the common iguana it is attached to the posterior cornua, opposite the omohyoideus. In the gecko *fimbriatus* it is fixed to the middle of the cornua, at the side and within the cerato-maxillaris: it forms, with the straight genio-glossus, the basis of the tongue, and mixes its fibres with those of the proper muscle. The hyoglossus is long and cylindrical in the lizards and tupinambis: it comes from the extremity of the posterior cornua, approaches the opposite muscle as it advances forwards, becomes contiguous to it at the basis of the organ, towards the extremity of which it terminates in forming the two portions of cylinders, of which this tongue consists. In the cameleon it is fixed to the whole anterior edge of the posterior cornua, and is very thick at that part. Beyond the angle formed by the two cornua of the same side, it is curved and continued directly forwards. The fasciculi of fibres, of which it consists, are inserted in the posterior half of the sheath of the tongue, which it serves to draw backwards.

2. The straight genio-glossi come from the inferior edge of the arch of the chin, and are continued to the basis

of the tongue; where they meet the hyoglossi, with which their fibres are interwoven.

3. The transverse genio-glossi are attached to the arch of the chin, and to the anterior part of the inferior maxillary branches, on the outside of the preceding. Instead of being narrow and elongated, they are broad and short. Their fibres pass obliquely from without, inwards and backwards upon the membrane of the mouth, as far as the sides of the tongue; which they will draw outwards and forwards. The two last pairs of muscles do not exist in the camoleon.

4. The proper muscle is found in those saurians only, whose tongue admits of elongation. It is composed, in general, of annular fibres. In the gecko fimbriatus, which has a broad tongue, this muscle is divided in front into six or eight small portions, which are united into two towards the middle third of the tongue, and then into one on each side, which form the two pieces of the basis of the tongue.

In the camoleon the annular muscle is very thick, and forms a fleshy cylinder surrounding the anterior three-fourths of that part of the os hyoides which penetrates into the tongue. Towards the front it is divided on the sides into two portions, a superior and an inferior; the latter is folded back towards the sheath of the tongue, to which it adheres. There is, moreover, a muscle proper to this sheath, which may be called the retractor muscle. It comes from below the glandular part, and is continued, on each side, as far as the part that is puckered up. When the hyoglossus throws this latter part into wrinkles, and shortens it, and the os hyoides is carried backwards by the sterno-hyoidei and ceratoidei, the retractor muscle causes the end of the sheath to remain applied to the extremity of the annular muscle which recedes, because then its posterior attachments are the most fixed: on the contrary, when the extremity of the os hyoides and the annular muscle push the sheath forwards, the anterior attachments have a point d'appui; the posterior portions of the retractor draw forwards the sheath, and unfold it.

By putting together what we have said concerning the os hyoides and its muscles in the camoleon, in a former part of this article, and what we have just said of the muscles of its tongue, it will be easy to understand how this organ can be elongated, and withdrawn into the mouth. The first office is performed by the annular muscle, with the cerato-maxillary, and the genio-hyoidei. The sterno-ceratoidei and hyoidei carry backwards the os hyoides, at the same time that the hyoglossus shortens the sheath and puckers it up.

In most of the ophidians the tongue is inclosed in a membranous sheath, which opens behind the interval of the branches of the lower jaw, and is continued backwards between those of the hyoid cartilage, under the trachea. It is lined internally by the membrane of the mouth. This sheath is carried forwards by a pair of muscles analogous to the genio-glossi. They derive their origin by two portions, one of which comes from between the two branches of the lower jaw, the other from their extremity; they come together and are fixed to the sides of the sheath to its most distant extremity. The hyoglossi are two elongated muscles, contiguous, and even united together by fine cellular laminae. They exactly fill the interval of the cornua of the hyoid cartilage, and are even doubled backwards round their extremity. These muscles go to the basis of the sheath, and draw it backwards, when it has been carried forwards by the two first pairs.

The proper muscle is formed of two cylinders, first lying

together, and separated towards the anterior third of the tongue, for the two portions of which its apex consists; here they become considerably diminished, and are reduced to a mere thread at the end.

This simple apparatus, combined with that of the os hyoides and its muscles, gives to the tongue of the serpent that wonderfully quick power of extension and retraction. Carried forwards by the genio-vaginal muscles, brandished by its proper muscles, it re-enters the sheath in consequence of the elasticity of the hyoideal cornua, which tend to restore themselves, and of the action of the hyoglossi. One or other of these actions is assisted by the costo-maxillary muscles, according as the portion analogous to the sterno-hyoideus, or that which corresponds to the cerato-maxillary, contracts. The extension of the tongue out of the mouth is so much the greater, because it is effected through an orifice near the extremity of the snout, and because its basis may be brought near to this part.

In the amphibia, which have a flattened tongue, not inclosed in a sheath, nor susceptible of extensive motion, there are, 1st, two genio-glossi attached to the arch of the lower jaw, more internally than the genio-hyoidei; 2dly, two hyoglossi; and 3dly, two cerato-glossi, which present nothing worthy of particular notice.

The tongue of the batracians, as we have already described, is fixed in front to the arch of the lower jaw, and free behind. In passing out of the mouth, and going back again, it turns upon the fixed point of its attachment to the jaw. Two pairs of muscles, the genio-glossi, and the hyoglossi, execute these motions. 1. The hyoglossi form, in the rana ocellata, two cylindrical masses, lying on, and attached to, the posterior cornua. They soon unite into a single mass, which rests on the hyoideal plate, and penetrates the tongue in front of this plate, expanding into small fasciculi, which reach to the loose edge of the organ. 2. The genio-glossi form at first two small spherical masses, placed at the arch of the chin on the small transverse muscle; they are subsequently elongated into two contiguous cylinders, of which the fibrous fasciculi separate from each other, decussate with those of the preceding muscle, and go to the loose edge of the tongue. While the tongue is in the mouth, the hyoglossus is folded on itself, and the genio-glossus is straight. The latter muscle is folded, and the former straight, when the tongue has been projected. In the common frog, these two pairs of muscles are not so minutely divided in the tongue, and the genio-glossi do not form spherical masses towards the arch of the chin: in other respects they are similar.

Tongue of the Crocodile.—Humboldt has observed a peculiar mechanism in the tongue of this animal, bearing an evident relation to its wants and habits, of which the following is a description in his own words.

"From the most ancient times disputes have existed concerning the tongue of the crocodile; some naturalists pretended that it was entirely wanting, others affirmed that it was very short, and placed at the entrance of the oesophagus. According as one or the other of these opinions prevailed, the sculptors and antiquaries of Rome amused themselves with destroying or restoring the tongues of their crocodiles. When we examine attentively the os hyoides of this animal, we find that it is in consequence of its form and small size that a part or rather a fold of the tongue has been confounded with the whole organ. There is in this animal a peculiar mechanism, by which a valve is formed, interrupting the communication between the mouth and throat. When the crocodile appears motionless on the bank of the river, with the jaws opened at an angle of

95°, the whole mouth appears yellow: the valve is elevated, and the opening of the fauces is not seen. If we surprise him, the valve is generally depressed; and if a person runs the risk of approaching sufficiently, a round body of a beautiful red colour, which is the opening of the glottis, may be perceived. This valve enables the crocodile to seize his prey under water without running the risk of being inundated by the great quantity of fluid that would pass into the œsophagus. When he swallows, the valve must be depressed, and the animal on dry ground. The os hyoides of the crocodile of the Orinoco is a membranous spatula, broad, concave, and terminated by two short horns. The os hyoides of the Egyptian crocodile, as delineated by Mr. Duvernoy, is altogether different from that of the South American animal; another proof of the distinction between the crocodiles of the old and new continent. In an animal of eighteen feet, the tongue is twenty-five inches: it is yellow, fleshy, and covers the whole jaw; but it is attached on all sides, so that the os hyoides cannot elevate it to the end. The anterior or spatula-shaped portion of this bone enters the membranous substance of the tongue, which it can elevate at a right angle. As the sides and extremity of the organ are fixed, this motion of the bone can only carry with it the membranous part of the tongue, which forms the fold presenting itself like an elevated valve. The os hyoides is depressed, and the valve immediately disappears. Three conditions are necessary to the execution of this mechanism, a tongue attached to the lower jaw; a ductile and flexible membrane covering it; and an os hyoides broad in front. The yellow substance in the anterior part of the mouth belongs to the tongue as well as the fold covering the entrance of the œsophagus. Humboldt found that the tongue swelled very much, when subjected to Galvanic influence, by means of zinc and silver. See *Recueil d'Observations d'Anatomie comparée et Zoologic, faites dans le Voyage de Humboldt et Bonpland*, t. 1. pag. 9. pl. 4.

Geoffroy gives a similar description of the tongue, os hyoides, and their mechanism, in the Nilotic crocodile. He describes it as a yellowish, shagreened skin, exactly like the substance of the palate, pierced by numerous small holes, the excretory ducts of the glands situated on its upper surface, and adhering on all sides to the branches of the lower jaw. He speaks of the broad anterior part of the os hyoides forming, by its elevation, a veil, which covers all the back of the mouth. Thus, the animal can remain under water with the jaws open, and receive air through the nostrils, the only part above the surface, without the water entering the throat or trachea. *Annales du Muséum*, vol. ii. p. 42, et seq.

Epiglottis.—In most reptiles the opening of the glottis is neither covered by a valve, as in the mammalia, nor armed with papillæ, as in birds. Yet a kind of epiglottis may be observed in the common iguana, and in the Schneiderian scink. There is a rudiment in the crocodiles; it does not appear in several other animals of the same order, nor in the chelonian, ophidian, and batracian reptiles. The cylindrical larynx of the dragon, and its simple opening behind the root of the tongue, are very well represented in Blumenbach's *Abbildungen Natur-Historischer Gegenstände*, N° 98. Is the absence of the epiglottis connected with the peculiar modification which respiration undergoes in this class? or with their deglutition? On the former point we may observe, that, as they breathe only at considerable intervals, there is no danger of the glottis being opened during swallowing, and its edges may consequently be kept closely approximated. Again, as they swallow their food whole, it is not likely to pass into the larynx.

Fauces.—The openings of the nostrils are situated very forwards in reptiles, and are not closed by any moveable curtain, as in the mammalia. A kind of immoveable valve, attached to the anterior edge of the opening, and leaving the orifice free behind, may be seen in the gecko *Simbrivatus*.

There is something analogous to the *velum palati* in the crocodile. The nostrils open far back, contrary to what we have mentioned concerning other reptiles. They form a round aperture in the most distant part of the arch of the palate. The membrane lining this concavity forms a loose production a little in front of the opening in question, which descends on the sides, growing a little broader, until it meets another elevation behind the basis of the tongue. These form together, by their loose edge, the *isthmus faucium*, or entrance of the throat. The first affords some protection to the opening of the nostrils, but cannot entirely close it; the latter contributes, with the rudiment of the epiglottis already mentioned, to cover the glottis.

The entrance of the throat is large in all reptiles, and capable, in many, of still greater size, by the expansion of the lower jaws. There is nothing deserving the name of *isthmus*. They swallow entire animals, which cannot pass into the nostrils, and hence do not require a *velum palati*.

Pharynx.—As the nostrils open forwards in reptiles, the pharynx has not the same relation to the nasal cavity, as in the mammalia and birds. The mouth and larynx communicate with it, and there is usually a large aperture corresponding to the Eustachian tube.

The pharynx can hardly be distinguished from the commencement of the œsophagus in reptiles. Their diameter is usually the same; and there is absolutely no difference in the aspect of the membrane forming their internal parietes. It presents a great number of longitudinal folds, which are effaced when a prey of large size is swallowed. There is no exterior muscle enveloping the entrance of the canal.

Deglutition may be assisted, in the chelonians, by the action of the *sterno-thyroidei*, which rest on the œsophagus in the whole length of the neck; and even adhere in front to its parietes, and to the part which may be regarded as belonging to the pharynx. The os hyoides may also contribute to deglutition, by means of the muscles which elevate it.

This office is particularly evident in the batracians, and especially in the frogs and toads. The hyoideal plate, which supports in these animals the extensive parietes of the back of the mouth and palate, is put in motion by the *mylo-hyoideus* and the muscles analogous to the *stylo-hyoidei*, only for the purpose of elevating these parietes, and applying them to the concavity of the palate. There is also another muscle coming from the upper and back part of the head, in front of that which corresponds to the *stylo-hyoideus*; it is narrow at its origin, but expands as it passes forwards and downwards, and as it covers that part of the throat which is prominent behind. It is continued to the edge of the hyoideal plate, in which it is inserted, its fibres adhering also to the membrane of the throat, on which they lie. Their action will elevate the hyoideal plate, and apply the membrane which they cover to the opposite surface of the cavity.

The longitudinal fibres, belonging both to the pharynx and œsophagus, are more or less strongly marked.

Œsophagus and Stomach.—The former tube does not present those dilatations which we notice in birds: it retains nearly a uniform diameter throughout, or the change, if any, is gradual. But this diameter is, in most cases, much more considerable, in comparison with that of the stomach, than in the two preceding classes. Under certain circumstances, indeed, the œsophagus is larger than the stomach

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in the ophidians; for example, when the latter is not distended with food, because its parietes contract sooner after enlargement than those of the œsophagus. The membranes are the same in both, and, when the tube increases in size insensibly to the stomach, it is often very difficult to assign the limits of the two parts, and consequently the situation of the cardia. The stomach is generally without any cul-de-sac, oval and elongated: its parietes usually thin. The muscular coat is then hardly perceptible, at least in some part of its extent, and the cellular is confounded with the mucous or internal. The pylorus is usually without any valve; it is marked by a simple contraction, by the greater thickness of the parietes of the stomach, and by the different structure of the intestinal membranes.

In the turtle, the internal surface of the œsophagus is beset with long, hard, conical papillæ, of which the points are directed backwards, with the effect, apparently, of preventing the return towards the mouth of the matters swallowed by the animal. Such, at least, is the notion generally entertained of the end or purpose of this structure. But the absence of such provision in all other animals, where the necessity seems equally to exist, cannot but render us sceptical on the subject, more particularly as we know no facts concerning the nature of the food, the mode of its deglutition, nor any peculiar modification of surrounding or connected organs, to which this singular structure might be supposed to bear some relation. The stomach is gradually diminished in size from the cardia to the pylorus: it is bent on itself, and the portion beyond the curvature is thicker than the rest, in consequence of the muscular fibres being more copious. The internal coat has longitudinal folds in this part, but hardly any in the other. The situation of the cardia is well marked, and the œsophagus is distinguished from the stomach by the sudden dilatation of the latter. The pylorus has no valve.

Among the saurians, the crocodile has a peculiarly shaped stomach; it is very distinct from the œsophagus by its globular figure. Near the insertion of this canal there is separated from it below a small cul-de-sac, opening into the intestine by a very small orifice, and having its cavity separated from the great sac of the stomach by a kind of strait. Consequently the general cavity of the stomach is a large cul-de-sac, of which the parietes are very thick. The internal membrane forms considerable plaits arranged in a serpentine form, like the convolutions of the brain. The cellular coat, which is not very distinct from the mucous in the œsophagus, becomes more so in the stomach. The muscular nearly equals the two others in thickness; the coats are altogether much thinner in the small cul-de-sac.

In the other saurians there is no cul-de-sac. The stomach is oval and very elongated in the iguana, without curvature; the œsophagus dilates gradually to form it. The only mark that can guide us in determining the situation of the cardia is, the cessation of the longitudinal folds of the internal œsophageal membrane. The stomach is suddenly contracted, and bent a little before its termination at the pylorus. Its parietes become thick and opaque at some lines from this aperture, from an increase of the muscular fibres, of which the transverse are strongly marked. The internal coat forms no fold; there is no valve at the pylorus, which is very small.

In the tupinambis the stomach forms a long tube, bent into almost a complete circle.

In the Schneiderian snake we again meet with the same elongated form, transparent parietes, and difficulty of distinguishing the stomach from the œsophagus, except by the longitudinal folds of its inner membrane, and the thickness

of its muscular coat. But the posterior part of the stomach contracts suddenly, is bent towards the right, and a little elongated in this direction before it terminates. The parietes of the latter portion are more thick and opaque, and its internal membrane is folded longitudinally.

The stomach begins by a small dilatation in theameleon, then it assumes a cylindrical and elongated form, and is bent on itself; it is considerably contracted before it terminates, and forms a small cylindrical canal, of which the internal membrane is folded longitudinally. The muscular coat is thicker in this contracted part than elsewhere. It forms a prominent ring at the pylorus.

In the dragon the stomach is shaped like a pear, of which the large end corresponds to the cardia; it has no curvature; its parietes are transparent; they become thicker and opaque near the pylorus; and these characters are the only circumstance, by which we can distinguish it from the beginning of the intestinal canal, which has thin and transparent coats.

The stomach is also pear-shaped in the gecko; the œsophagus makes a curve before it ends, and is inserted at one side of the basis. It is narrow, with thick coats, a strong muscular covering, and broad longitudinal folds of the internal or mucous coat. The sides of the organ are thicker at its extremities; and the pyloric end is a little bent. The internal membrane is smooth.

In the ophidian order the stomach is shaped like an intestine, hardly larger than the œsophagus, and without curvature. The internal membrane is folded longitudinally. When the stomach is empty, these folds are thicker than those of the œsophagus, which are not always observed.

The œsophagus of a snake, examined by Spallanzani, formed a cylindrical tube like an intestine, for about nine inches: it then became gradually narrower, so as to constitute a funnel of the length of four inches and a half. This funnel was the true stomach. The sides of the stomach were thicker than those of the œsophagus: no glands or follicles could be seen in the latter; but the stomach was abundantly supplied with them throughout its whole length; they discharge part of their liquor on being pressed, and the internal coat is moistened with it. Dissertations relative to the Natural History of Animals and Vegetables, v. 1. p. 112 and 113.

In frogs and toads the stomach is shaped nearly as in the chelonian reptiles. At first considerably dilated in comparison with the œsophagus, it is gradually contracted, then curved so as to form an intestine-like canal, with thick coats, ending at the pylorus.

It is slightly curved only near its posterior extremity in the salamanders. Its figure is elongated and not much swollen; the parietes thick; and the internal membrane exhibits small rugæ. There is a fold near the pylorus, in the situation of the curvature. Figures of the stomach and intestines of various reptiles are given in Cuvier's *Leçons*, pl. 41.

Intestinal Canal.—Its length, in proportion to that of the body, is greatest in the mammalia, and diminishes successively in birds, reptiles, and fishes. In reptiles it is often hardly twice the length of the body, taken from the extremity of the snout to the anus. But tadpoles exhibit in this respect a remarkable peculiarity. Their intestinal canal is nearly ten times as long as the space between the snout and anus, while in the frog it is not more than twice the length of the corresponding space. Other important differences, which will be noticed subsequently, exist in the two cases. This shortness of the alimentary canal corresponds to the nature of the food in reptiles, which is derived from the animal kingdom.

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The following table of the length of the intestinal canal in various reptiles, is taken from the third volume of Cuvier's *Léçons d'Anatomie comparée*, p. 457.

Names.	Length of the body.	Length of the small intestine.	Length of the large intestine.	Length of the whole canal.	Proportion to the length of the body.
Testudo græca - - -	0.210	0.680	0.014	0.694	:: 1 : 3.3
Nilotic crocodile (adult) - -	1.690	5.384	0.406	5.790	:: 1 : 3.4
Nilotic crocodile (young) -	0.240	0.710	0.036	0.986	:: 1 : 4.1
Gangetic crocodile (gavial) - -	0.360	1.350	0.040	1.390	:: 1 : 1.1
Cameleon - - -	0.130	0.180	0.040	0.220	:: 1 : 1.7
Gecko à goutelettes (gecko guttatus)	0.125	0.120	0.053	0.173	:: 1 : 1.3
Schneiderian feink - - -	0.150	0.230	0.171	0.401	:: 1 : 2.8
Iguane ardoisé (iguana cærulea) - -	0.180	0.175	0.062	0.237	:: 1 : 1.3
Common iguana - - -	0.220	0.400	0.230	0.630	:: 1 : 3
Lacerta agilis - - -	0.088	0.050	0.017	0.067	:: 1.3 : 1
Common snake (coluber natrix)* - -	0.500	0.530	0.050	0.580	:: 1 : 1.2
Toad - - -	0.065	0.110	0.028	0.138	:: 1 : 2
Frog - - -	0.070	0.100	0.034	0.134	:: 1 : 2
Tadpole of the frog - - -	0.035	0.300	0.030	0.330	:: 1 : 9.7
Salamander - - -	0.040	0.080	0.022	0.102	:: 1 : 2.5

* In a common snake of four feet in length, Blumenbach found the intestinal canal about three feet, nearly straight, or at least very slightly undulated: its proportional length was therefore different from that expressed in the table. *Specimen Physiol. Comp.* p. 30.

The intestinal canal of reptiles has in general no appendix to mark its division into large and small intestines; this division exists nevertheless in most of them. All the chelonians, most of the saurians, the ophidians, and the batracians, with the exception of the green lacertina, have a long and slender intestine, inserted into a large and short intestine, and commonly prolonged into the cavity, so as to form a circular margin of a valve-like form. The sides of the large intestine are almost always thicker and stronger than those of the small. The membranes differ too; the muscular in respect to its longitudinal fibres, and the internal in its folds. The iguana is the only animal of this class, in which a true cæcum has been noticed.

Of the Intestinal Canal.—All reptiles have the intestinal canal very short, but not of the same diameter in its whole length. In the first and most considerable portion, the capacity is much inferior to that which it is found to possess near its termination; so that it may be divided, as in the mammalia, into small and large intestines. A circular valve is most frequently found separating the two divisions; it is formed by a prolongation of the small intestine, which becomes dilated, and sometimes is extended into a kind of sac, projecting more or less into the cavity of the large intestine, and rendering the parietes double at that part. It is thus found in the Schneiderian feink.

In tortoises, the diameter of the small intestine gradually diminishes from the pylorus to the point of its insertion into the large: the area of which is four times greater than that of the small, and its parietes have the same structure as in the other reptiles. The cavity is regular throughout, there being no partial dilatations or sacculi. The internal membrane has folds, more or less broad, and of a membranous structure, in different species, sometimes connected in a reticular form at the commencement of the small intestine, having a longitudinal and parallel direction in the rest of its extent, and arranged more or less irregularly in the large. The large intestine proceeds in a straight direction to the anus, whilst the small makes many irregular turns in its course.

Blumenbach found the intestinal canal of the hawk's-bill turtle (*testudo caretta*) five times as long as the whole animal. The small intestine, as it is called, was larger than the short portion of the large intestine; the whole internal surface was covered internally with an abundance of mucus. *Syst. of Compar. Anat.* p. 173.

The internal coat of the intestine of the turtle is covered with innumerable thin longitudinal processes, lying close together, and increasing the surface of the gut to a vast extent. They are most numerous in the upper part of the canal, and gradually diminish in number, until they cease altogether, below. In the latter respect they resemble the valvulæ conniventes of man, and the villi of all animals. For these structures are always most distinct at the commencement of the canal, where absorption goes on to the greatest extent. The alimentary matter is deprived more and more of its nutritious parts, as it descends in the intestine; and hence a less extensive absorbing surface is sufficient, in the lower part of the canal, for taking up the remains of really nutritious particles. Yet Blumenbach says that he found these folds so numerous in the rectum of the hawk's-bill turtle, that a section of the gut resembled a broad radiated band. *Lib. cit.* p. 173, note.

In the crocodile of the Nile, the small intestine may be distinguished into two portions, the one more capacious, having thinner coats, and making four turns in such a manner as to form four permanent angles; the other, more contracted and having thicker parietes, incloses between its internal and muscular coats a layer of glandular substance, semi-transparent, of a grey colour and pulpy consistence. In the internal membrane lining the glandular substance, there are seen longitudinal folds arranged in a zigzag form, and connected together laterally, by smaller folds, so as to form a reticular surface. In the first portion of the small intestine, where the glandular substance is not manifest, the folds arranged in a zigzag form are replaced by fine villous eminences. Near the termination of the small intestine there are only seen some waving folds, connected by a few, proceeding transversely. In the large intestine, the folds are arranged irregularly, forming a velvet-like surface.

The form of the rectum (under which term is included the large intestine of fishes and reptiles) is cylindrical in the crocodile of the Nile; and the small intestine, where inserted into it, is nearly of equal diameter. In the gavial (*Gangetic*

(Gangetic crocodile), the large intestine has a pyriform figure, the termination of the small being inserted into its broadest part.

In the lizards, the rectum is cylindrical, and much broader than the small intestine which is inserted into it; the latter, after having turned forwards from the pylorus, is folded backwards, and proceeds in a tortuous direction as far as the rectum, which pursues a straight course to the anus. The parietes of the intestinal canal are thin and transparent; the internal membrane has folds arranged in a zigzag form.

In the camoleon, the coats of the intestine have the same structure; the capacity of the small is not much inferior to that of the stomach and large intestine, in the greatest part of its extent; but it becomes much contracted a little before its insertion into the latter. There is no valve indicating the separation between the different portions; the internal membrane has waving folds, the loose edges of which have a fringed appearance; they are directed longitudinally, and contracting as they approach the rectum, disappear at some distance from that intestine, where the internal membrane becomes smooth and without any folds. The muscular coat is thicker in the rectum than in the small intestine, where it is indistinct. The cellular coat is not manifest.

In the dragon, the intestinal canal forms two turns and a half before it arrives at the anus; the commencement is distinguished only by the different appearance of its coats, which are much thinner than those of the stomach.

In the iguana, the parietes of the intestinal canal are thin and transparent, gradually contracting from the pylorus to the insertion of the small intestine into the rectum; the latter is of an elongated form, but contracted at one part, by which it becomes divided into two portions almost of a cylindrical shape. The internal membrane has some folds directed longitudinally in the small intestine. In the common iguana, which has the intestinal canal long and very capacious, there is a true cæcum, distinguishable from the large intestine by the greater thickness of its coats, and by a partition separating their cavities, so that it is through a very narrow orifice that the fecal matter passes from the cæcum into the succeeding part of the large intestine. The insertion of the small into the former takes place near its middle. The coats of the cæcum have in some degree a sacculated form. The internal surface is smooth and without folds. In the large intestine the internal membrane has the same structure, except at the commencement, where there are found about six transverse valves, which do not extend around the whole tube of the intestine. In the small intestine there are longitudinal folds. The pouch formed by the cæcum is about three-fourths of an inch in length, and twice as much in breadth.

In the gecko à gouttelettes the parietes of the intestine are also transparent, the small has but little capacity, but is unequal at different parts; it is inserted into the centre of the first portion of the large intestine, which is of a globular form; and is separated, by a contraction in its coats, from the second portion, which is elongated and oval, the small extremity corresponding to the anus. In the Schneiderian scink the thin and tender coats of the intestinal canal are much dilated at the commencement of the small intestine, and contracted at the part where it is introduced into the large. We have already mentioned that it is dilated into the form of a bladder, and enveloped by the first portion of the large intestine, similarly dilated. The excrements, which pass through the small aperture in the vesicular dilatation of the small intestine, find their way partly into the interval between the latter and the internal surface of the large. Beyond the first portion the rectum becomes cylindrical. The

small intestine is divided into many pouches by contractions which pretty nearly correspond to its different turns.

In the ophidian order the intestinal canal pursues a serpentine direction as far as the rectum, and preserves nearly the same diameter throughout, dilating but little in the large intestine. In the small, the internal membrane forms broad longitudinal layers, folded in the manner of ruffles; it is rugous, and in the rectum forms thick, irregular folds, which are continued to the anus. In the coluber natrix, according to Blumenbach, the whole length of the intestinal canal does not equal that of the animal. The small intestine forms a very considerable valve at its entrance into the large. Lib. cit. p. 174.

In the salamanders, the small intestine is very narrow in comparison with the rectum, where the internal membrane forms thick and simbriated folds. In toads and frogs, we find a nearly analogous conformation and structure, there being only a slight variation in the form of the rectum, which is more or less of a conical or pyriform shape, as in many frogs, or cylindrical, as in toads. But in the tadpoles of both, the intestinal canal is altogether very different from that of the same animal in the perfect state. Long, narrow, and nearly of uniform diameter in the small intestine, making irregular turns in its course, its volume augments at the rectum, which becomes of a sacculated form, and makes two spiral turns upon itself, before it proceeds to the anus. There is no valve separating the two portions of the intestine.

In the firen lacertina the intestinal canal proceeds almost in a straight course from the pylorus to the anus, making but one small turn near its middle, from which it proceeds straight to its termination. Its coats are transparent, and its diameter nearly equal throughout, not admitting of any division into small and large intestines.

Physiology of the digestive Organs.—Blumenbach asserts that most reptiles are omnivorous, while some are confined to one species of food, as the bufo or rana calamita, which feeds on a few species only of insects, and those alive. (Specimen Physiol. Comp. p. 29.) We cannot help doubting the accuracy of the first part of this statement: the food seems to us almost entirely animal. Serpents, frogs, and lizards, live on the smaller animals or insects; and even the turtles, which eat particular kinds of marine plants, feed also on the mollusca. The simple stomachs, the simple and short alimentary canals of the whole order, correspond very clearly to what we understand concerning their carnivorous habits. Newts seem to care for living insects and worms only, which they seize with their jaws, and swallow whole.

Two apparently contradictory circumstances have been noticed in this order; great voracity in many instances, but in all a wonderful power of abstinence. Salamanders sometimes devour their own excrement, and earth. Serpents often take in a quantity of food, which distends their bodies inordinately, and leaves them inactive, and hardly capable of motion. The salamanders will sometimes stuff themselves to such a degree with worms, that they crawl up again out of their stomachs. See Spallanzani's Dissertations, vol. i. p. 110.

"A newt," says Bonnet, "having devoured a large earthworm, I supplied it with another above four inches long, and thick in proportion. It immediately swallowed the whole, except a line or two that hung out of the mouth; but the worm was soon thrown up, and the same repeated twice, but the worm still lived." Spallanzani's Tracts, vol. ii. p. 366.

The instances which are recorded of the abstinence of reptiles seem at first almost incredible. Not to mention the toads,

toads which have been found inclosed in blocks of stone, and which probably have been in a torpid state, nor the more common instances (see L. Th. Gronovius ad Plinium de Aquatiliu Natura, p. 38.) we have the respectable authority of Caldeſi for the fact of tortoiſes having remained without food, and not in a torpid ſtate, for a year and a half. Blumenbach reports of a tortoiſe, which he kept for three quarters of a year, that the harmleſs creature never ate any thing the whole time, although every thing that the houſe and garden afforded was offered to him. For the laſt three months (from November to February) he exhibited the loweſt degree of vitality, manifeſted, in addition to extremely ſlow locomotion, with almoſt cloſed eye-lids, merely by the ſingle ſenſe of touch or feeling, particularly of warmth and drafts of air. When he died, the muſcles were as fleſhy and freſh-coloured as in the beſt nourished tortoiſes. Abbildungen, &c. No. 66.

Redi had a land tortoiſe live eighteen months, a camelion eight, and vipers ten, without food. (Spallanzani's Tracts, Introduction, p. 42.) Toads were quite lively at the end of fourteen and eighteen months, inclosed in pots. Ibid.

Blafius mentions, in his "Anatomia Animalium," that a land tortoiſe which he kept ten months would take no food during the whole time.

Bonnet, ſpeaking of newts, ſays, "theſe animals can ſupport the want of food very long. Some of mine have lived two months without it. Sign. Spallanzani had remarked the ſame; and obſerved, that although long deprived of nutriment, they reproduced their members equally well as thoſe plentifully ſupplied with ſuſtenance." (Spallanzani's Tracts, v. 2. p. 364.) Blumenbach has kept ſalamanders eight months without taking food, or appearing to ſuffer from the want of it. (Handbuch der Natur geſchichte, p. 220.) Daudin aſſerts that ſnakes and vipers may be kept for ſix months without food, yet ſeem to loſe none of their activity: t. 1. Introd. p. 270.

Some protei, which Dr. Schreiberns of Vienna had kept in his poſſeſſion for two years, had taken no food, and were quite well. (Cuvier, Rech. ſur quelques Rept. douteux; l'Anat. du Proté.) Bruce ſtated that he had kept the caſeakes in a bottle for two years without food, and Lacépède reports, on the authority of Shaw, that a Venetian apotheecary kept two of theſe faſting for five years. (See Daudin, vol. vi. p. 186.) This power of faſting belongs, in a greater or leſs degree, to the whole order. For a compariſon between the power of abſtinenſe of warm-blooded animals and reptiles (the ſtate of torpidity being excepted), ſee Diſſ. Acad. Inſtit. Bonon. ap. Benediſtum 14. Pont. Max. de fervor. Dei Beatificatione, lib. 4. p. 1. pag. 328.; alſo Beccarius in Comm. Inſtit. Bonon. t. 2. p. 1. pag. 223.

No reptiles masticate: the herbivorous amphibia gnaw off the vegetable productions on which they feed, but they do not chew them. The ſtructure of their jaws, teeth, and tongue, gives them the power of ſwallowing entire animals: this proceſs of deglutition, being often exerciſed on animals as broad as themſelves, and broader, is very ſlow, and occupies even hours. The œſophagus muſt of courſe poſſeſs a great power of dilatation. In his account of the newt, Bonnet ſays, "that worms are ſeized with a ſudden motion of the animal's jaws, and ſwallowed alive, with gentle ſhocks of the whole body, and particularly of the anterior part. The prey is always ſwallowed without mastication: the minute teeth, which are not employed in chewing, ſerve to prevent the eſcape of the animal, which twiſts itſelf about moſt actively. Long worms are devoured entire, notwith-

ſtanding all their exertions to eſcape. They twine round the neck of the newt like a ſerpent: every moment they become ſhorter, and gradually diſappear. Thus have I ſeen a newt ſwallow a worm more than ſix inches long in leſs than five minutes. A large worm, ſeized by the middle, is ſeldom ſwallowed in the ſame poſition, becauſe it is too large, if doubled in the mouth, and the newt gradually ſhakes it out, until it can ſeize one of the extremities; which being accompliſhed, the worm is ſoon devoured. However, I have obſerved a large one ſwallow a worm taken by the middle, without ſeizing an extremity; but a quarter of an hour was occupied in the meal. The ſucceſſive motions of deglutition are very ſenſible; it is performed by repeated ſhocks. Though they have flexible jointed fingers, they make no uſe of the hand, either to ſeize their prey, convey it to the mouth, or retain it there." Spallanzani's Tracts, v. 2. p. 364.

The length and capacity of this tube, and its large communication with the ſtomach, are well ſuited to the nature of ſerpents. The prey, always ſwallowed without mastication, is often too long to paſs entirely into the ſtomach: it remains in the œſophagus until room is made for it. Travellers have even aſſerted that one end of an animal ſometimes hangs out of a ſerpent's mouth, while the other is in the ſtomach.

As there is no mastication in this claſs, nor any proviſion like the gizzard of birds, for comminuting the food when ſwallowed, the proceſs of digeſtion muſt be effected by the action of the ſtomach alone on the prey ſwallowed entire. The juices of the organ are fully adequate to this effect; and the proceſs has been demonſtrated by experiment in ſeveral genera by Spallanzani. He inclosed food in tubes, and conveyed them into the ſtomach of the frog, the newt, and diſſerent ſerpents; and always found that it was diſſolved in a longer or ſhorter time: it thus appears that the eſſential nature of digeſtion is the ſame as in the warm-blooded animals: but the proceſs exhibits ſome modifications, as the diſſerent nature and habits of the animals would naturally lead us to expect. The chief difference is that the ſolution requires a conſiderably longer time than in warm-blooded animals. The fleſh in the tubes, conveyed into the ſtomachs of frogs, was not completely diſſolved until the third and even the fifth day. (Diſſertations, v. 1. p. 102.) Yet although the gaſtric liquor of frogs acts ſo ſlowly, it is capable in time of diſſolving even bone: Spallanzani met with a mouſe in the ſtomach of a frog; all the ſoft parts of the limbs were gone, ſo as to have only the naked bones, which were conſiderably waſted, and converted into a ſemi-gelatinous ſubſtance. (Ibid. p. 102.) Earth-worms encloſed in tubes were converted into a whitish pulp in thirty hours, in the ſtomach of the water newt; p. 104. He found numerous ſmall white worms in the ſtomachs of three-fourths of all the newts he examined, from five or ſix in number to a hundred and more. Theſe were ſo delicate that they would not bear even ſlight preſſure; and thus afford a proof that nothing like trituration can go on in the ſtomach, but that digeſtion is ſimply ſolution by the gaſtric liquor; p. 104—111. In ſerpents the proceſs occupied from two to five days. The tibiae of frogs were almoſt completely diſſolved in five days; § 118—122. As the animals ſwallowed by ſerpents often lie in part in the œſophagus, a queſtion ariſes, whether they undergo any digeſtion in that tube, or whether this function be the excluſive attribute of the ſtomach. A viper, ſays Charas (Deſcrip. Anat. de la Vipère,) vomited a lizard, which had been ſwallowed twelve days before. All the front of the body, which had been in the ſtomach, had merely

merely the bones remaining, while the other parts were nearly as perfect as if they had been swallowed the same day. Spallanzani confirmed this want of digestive power in the oöphagus, by direct experiment; § 125. Naturalists, says this indefatigable inquirer, were already apprized of the tardiness of digestion in serpents. Bonare, in his *Diët. d'Hist. Naturelle*, gives an account of a serpent at Martinique, which retained a chicken in its stomach for three months, and did not completely digest it. "It is remarkable that flesh does not become fetid from remaining long in the stomachs of these cold animals, which I had occasion to observe particularly in a viper. A lizard was retained in its stomach for sixteen days, at the end of which time it had no odour but that of the gastric juice. Yet such was the heat of the season, that another lizard, which I had placed in a close vessel, containing a little water, emitted an insupportable stench before the expiration of the third day; § 127. The gastric liquor of a snake approaches in colour to that of foot; it had the fluidity of water, and evaporated very slowly; it had both a salt and bitter taste, and was not inflammable. It strongly resembled the gastric fluid of other animals, and this resemblance extended to the odour, which was exactly like that of the corresponding juices of birds of prey; § 123.

The idea of Blumenbach, that the venom of the poisonous serpents supplies the place of mastication, and promotes digestion by some septic power, seems completely unfounded. It is a provision calculated merely for purposes of offence. Where is this septic power, or what supplies its place in the harmless serpents, and in all other amphibia?

The whole alimentary canal of the amphibia abounds with a viscid tenacious mucus, the abode of several genera of worms.

Blumenbach failed completely in very numerous and diversified attempts to cram frogs and lizards with madder root, and thus to produce in their bones that beautiful rose colour, which is so quickly produced in the mammalia of birds, when thus fed. *Specimen Physiol.* p. 31.

Absorbing Vessels.—This system has been very little examined by anatomists, probably on account of the minuteness of the tubes, and the consequent difficulty of injecting them. We have nothing to add to the account given by Hewson, who first described them in the *Philosophical Transactions*, 1769.

No lymphatic gland has been yet seen in a reptile: birds have none in their mesentery, but they are seen connected to the large lymphatics of the neck.

It has been asserted that the chyle is colourless, and hence anatomists have explained why the vessels were so long undiscovered. In animals which have white chyle, the appearance of this fluid through the transparent coats of the lacteals supplies the place of injection, and affords an easy method of demonstrating them. Mr. Hewson states that he saw white chyle in a crocodile.

The distribution of the lacteals (if that term may be employed where the chyle, instead of being like milk, is transparent) on the intestine of the turtle, forms one of the most elegant preparations in comparative anatomy. By fixing the injecting tube in a vessel near the intestine, and waiting with a little patience, the quicksilver will gradually find its way into the minute ramifications of the lacteals. The large trunks on the mesentery contain valves, so that we cannot succeed in filling the absorbents of the intestine from them; but the ramifications on the intestine itself are destitute of these folds, so that when once the quicksilver has reached the surface of the gut, it will run forward without any obstacle. The peritoneal surface of the gut is com-

pletely covered with straight parallel branches, running according to the length of the intestine. Its inner surface is no less thickly covered with lacteals of a different appearance. When dried it seems as if the quicksilver were contained in small cells, covering the whole internal surface of the intestine so completely, that the point of a pin could scarcely be placed between them. Mr. Hewson has particularly described this appearance, and was doubtful whether it ought to be referred to extravasation or not. But we are convinced, from frequent examinations of this cellular structure, that it is a part of the natural organization; because the cells are regular and uniform in their size and arrangement; no force is used in the experiment; and a real extravasation presents an appearance altogether different. The extent of the absorbing system, as demonstrated in this way, is beyond any thing we could form an idea of from injections in man or warm-blooded animals.

After leaving the intestine, the lacteals accompany the blood-vessels on the mesentery, running at their sides, and communicating across them. Each artery has two veins, and there is a lacteal or more at each side of each of the three vessels; so that their number considerably exceeds that of the blood-vessels. A coarse representation of them, on the mesentery, is exhibited in Monro's *Physiology of Fishes*, tab. 30.

Near the root of the mesentery the large lacteals anastomose, so as to form a net-work, from which several large branches go into some considerable lymphatics on the left side of the spine. These last can be traced downwards almost to the anus, and belong to the parts situated below the mesentery, and particularly to the kidneys. At the root of the mesentery, on the left side of the spine, the lymphatics of the spleen join the lacteals, and immediately above this union a sort of plexus or net-work is formed, which lies upon the right aorta. From this plexus a large branch arises, which passes behind the right aorta to the left side, and gets before the left aorta, where it assists in forming a large receptaculum, lying in front of that artery. The thoracic ducts arise from this receptaculum. From its right side goes one trunk, which is joined by that large branch which came from the plexus to the left side of the right aorta, and then passes over the spine. This trunk is the thoracic duct of the right side; for having got to the right side of the spine, it runs upwards on the inside of the right aorta, towards the right subclavian vein. And when it has advanced a little above the lungs, or within three or four inches of the subclavian vein, it divides into branches, which, near the same place, are joined by a large branch that comes up on the outside of the aorta. From this part upwards, those vessels divide and subdivide, and are afterwards joined by the lymphatics of the neck, which likewise divide into branches before they join those from below; so that between the thoracic duct and the lymphatics of the same side of the neck a very intricate net-work is formed. From this net-work a branch goes into the angle made by the jugular vein, and the lower part, or trunk, of the subclavian: this branch, therefore, lies on the inside of the jugular, whilst another gets to the outside of that vein, and seems to open into it a little above the angle between that vein and the subclavian. Into the above-mentioned receptaculum the lymphatics of the stomach and duodenum enter: they have numerous anastomoses, forming a beautiful net-work round the artery which they accompany. From this receptaculum likewise, besides the trunk already mentioned, which goes to the right side, arise two other trunks, nearly equal in size; one of which runs upon the left side, and the other upon the right side of the left aorta, till they come within two or three inches of the left

left subclavian vein; where they join behind the aorta, and form a number of branches, which are afterwards joined by the lymphatics of the left side of the neck: so that here a net-work or plexus is formed, as upon the right side. From this plexus a branch issues, which opens into the angle between the jugular and the lower part or trunk of the subclavian vein. In these net-works, formed by the lymphatics near their termination in the veins, this system in the turtle differs remarkably from that in birds. Hewson's Account of the Lymphatic System in Amphibious Animals, Philos. Transf. vol. 69. p. 198.

The Liver, which is divided in the mammalia into several lobes distinct from each other, and is more uniform in birds, is still less divided in reptiles. Often it has no division of lobes, but is merely irregularly fissured on its loose and thin edge. Its proportionate size, however, is more considerable than in the two classes just mentioned. Occupying usually the two hypochondria, it extends far backwards under the intestines, and is supported in its position by folds of the peritoneum, analogous to those which exist in the mammalia. Its colour is no longer that reddish-brown which is seen in the mammalia and birds; but it partakes more of yellow.

In the chelonians the liver exhibits a peculiar arrangement, being divided into two rounded irregular masses, of which the right occupies the same hypochondrium, and the other is connected to the small curvature of the stomach. They are united by two narrow productions of the same substance, in which the principal vessels pass. In the green lizard, the geckos, the dragons, the iguanas, it forms a single mass of various figure, flat or convex below, concave above. Its loose edge has two fissures in the dragon, dividing it into three lobes, of which the right is prolonged into a sort of tail. There is only one fissure in the geckos, and the right part is equally more extensive than the left. In the common iguana it is lengthened into a long appendix. In the crocodile and camelion the liver has two very distinct lobes; and moreover, in the latter, a long appendix. It has only one lobe in the serpents, in whom it is long and cylindrical. Like other organs, it assumes in this order a figure corresponding to the elongated form of their bodies. There is one lobe only in the salamanders, but two in the other batracians.

Hepatic Canals.—The common trunk of these canals is usually separate from the cystic duct, and not inserted with the latter in the intestinal canal, in reptiles, as well as in birds. This has been observed in the chelonian and saurian orders, in several ophidians, and some batracians. Yet this arrangement is not constant. For, in the crocodile, where the hepatic is sometimes separate from the cystic duct, it sends at other times a branch to the gall-bladder, which is inserted a little above its neck, and is itself united to the cystic canal, not far from the intestine. The mouth of the common canal was distant from the pylorus, says Cuvier, 0.26 in a crocodile, whose whole intestinal canal was rather more than a metre (about 39½ inches) in length.

In the testudo græca the hepatic canal sends a branch of communication to the cystic canal, not far from the gall-bladder; but these two canals open separately into the intestine, though near each other; the former before the latter.

The Gall-Bladder has its fundus usually directed backwards. Its proportional volume is less considerable than in mammalia and birds; and it is more intimately connected with the liver than in these classes. In the testudines it is almost entirely concealed in the right lobe of the viscus; and is placed under the same lobe in the crocodile. Where the liver is not divided into lobes, the situation of this refer-

voir is marked out by a fissure. In the ophidians the gall-bladder is absolutely separated from the liver, and situated at the side of the stomach, near the pylorus, a short distance beyond the posterior extremity of that viscus. Its form is generally oval, but it approaches to the cylindrical figure in the iguana.

The connections of the cystic and hepatic canals have been already mentioned. The former remains generally distinct from the latter, by the side of which it is inserted into the intestine. Sometimes it receives the branches of the latter in succession.

The Pancreas is a conglomerate gland, as in mammalia and birds, and possesses the same structure (with some unimportant modifications of colour, consistence, lobular divisions, &c.) as in man. Its position and figure vary in reptiles. In several chelonians it is triangular. That of the Nilotic crocodile is divided into lobes: it is irregular in the ophidians, and situated on the right of the origin of the intestinal canal. In the frog its figure is equally irregular, and it is situated in the arc formed by the stomach towards the front. It is placed in the first curve of the intestine in the salamander.

There is either a single or double pancreatic canal. In the Nilotic crocodile, for example, there are two, inserted in the intestine after the biliary canals, while there is only one in the land salamander, the insertion of which precedes that of the biliary tubes.

The Spleen.—This is a viscus, of which the use is not hitherto understood. It exists in all the vertebral animals; but its importance seems to diminish as we pass from mammalia to birds, from the latter to reptiles, and from these again to fishes; at least, if we may judge from the succellive diminution of its volume in these four classes.

Its figure varies considerably in this class. It is shaped like the kidney in the testudines; small and spherical in the frogs and toads; elongated in the salamanders, as well as in the saurian and ophidian orders.

The abdominal Cavity, Peritoneum, and its Processes.—The offices of this membrane, in covering and insulating the various viscera, confining them, by its continuations and folds, more or less closely to the sides of the cavity, and facilitating, by its smooth surface, their motions with respect to each other, and to the containing cavity, will convince us of the importance of the membrane, and lead us to expect that it should exist very generally. We, consequently, find it in all the vertebral animals. Generally white, delicate, and transparent, it is sometimes black in reptiles.

In this class, as in birds, there is no diaphragm, and consequently no distinction of abdominal and thoracic cavities. All the viscera are contained in one large cavity, and surrounded by one membrane. Geoffroy, however, describes some muscular fibres coming from the sternum, and fixed to a membrane covering the convexity of the liver, which seem like the rudiment of a diaphragm. Annales du Muséum, v. ii. p. 50.

In the chelonians, the membrane produces certain subdivisions of the common cavity of the thorax and abdomen. We remark, 1st, the cavity of the lungs, which are continued far backwards, above the heart, liver, and intestines; 2dly, that of the heart, or pericardium, which touches the following behind; 3dly, that of the abdominal viscera, containing the stomach, liver, intestines, ovaries, testicles, and urinary bladder. In front it covers the liver, forming a sort of membranous diaphragm, separating it from the heart; and it closes the cavity of the pelvis behind. It also furnishes the mesenteric folds. The texture of this membrane appears stronger in the testudines than in other reptiles.

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The mesentery exhibits, in the different orders of reptiles, some varieties, which we shall shortly notice. The first fold, which is attached to the small intestine in the testudines, does not come immediately from the vertebral column, and does not form the mesentery properly so called, until after it has fixed the arch of the colon by means of a mesocolon. The duodenum is confined in the right hypochondrium, and joins, by laminae of the common membrane, which cover it, and are then continued to the abdominal parietes. The mesentery of serpents is a narrow fold, not coming immediately from the vertebral column: the blood-vessels form numerous anastomoses between its laminae, as in warm-blooded animals.

The saurians have a mesentery tolerably developed. The production, which goes to the large intestine, like that which belongs to the small, comes from the vertebral column. There is no transverse mesocolon.

Reptiles have no omenta; but structures apparently analogous to these fatty membranes occur in some of them. The serpents have membranous processes, containing much fat, and extending, like the great omentum of the mammalia, under the intestinal canal. Many saurians have also two productions of peritoneum, loaded with fat, advancing from the front edge of the pelvis under the abdominal viscera; there are fatty lobes attached to the testicles and ovaries of frogs. The latter are not regarded by Blumenbach in the light of omenta. "The yellow appendices," says he, (*ductus adiposi, appendices luteae*;) "which are found in the frog, on either side of the spine, and sometimes form one mass, sometimes are divided into several smaller portions, were considered by Malpighi as a kind of omentum. (*De omento et adiposis ductibus*, oper. t. 2. p. 35, &c.) That this resemblance is very remote, appears from several circumstances; and particularly from the constant and remarkable variations of size which occur in these parts at the pairing season." Comparative Anatomy, translated by Lawrence, p. 193.

These bodies, being apparently connected to the testicles and ovaries, are described with the generative organs by Swammerdam and Roefel. They consist of a pedicle, attached more particularly to the emulgent vein on each side, and of two, three, to seven or more pieces joined to it, varying in size according to the age and season. They are proportionally large in the tadpole. They may be seen small in female frogs, which have not yet laid their ova, although Roefel asserts that they increase in size with the generative organs. In this small state, Cuvier observes, that a vessel, filled with venous blood, and producing no branches, may be seen in the axis of each fringed portion. These vessels all join to form a common trunk in the pedicle; and this trunk terminates in the emulgent vein.

The absence of omentum in this class does not accord with its supposed use to keep the intestines warm. Is there any proof that the intestines are warmer with it, than they would be without it? And is there not as great a necessity for preventing the escape of heat in reptiles, or in birds, (which also have no omentum,) as in the mammalia? Cuvier observes, that many of the hibernating mammalia have two lateral omental appendices, which, with the principal omentum, are abundantly furnished with fat in the winter, so as to form "an adipous covering for the intestines, which no doubt contributes powerfully to retain their natural heat, to prevent the access of cold, and to supply the place of food." All reptiles are torpid in the winter, yet they have no omenta.

Urinary Organs.

The Kidnies.—These are distinguished from the same

glands in mammalia, and resemble those of birds and fishes, in the impossibility of distinguishing in them the two substances (see KIDNEY), and in the absence of infundibula and pelvis. Their situation, form, and relative size, vary in the different orders.

In the chelonians and saurians, they lie far back in the abdominal cavity. They adhere closely to the pelvis in the lizards properly so called, under the sacrum, and penetrate even under the tail; they go as far back, but they advance farther in front, in the salamanders. They lie altogether farther forwards, and very near each other, in the other batracians. In these three orders both kidneys are situated at the same height, and covered by the peritoneum on their inferior surface only. In the ophidians, the right is placed further forwards than the left; and they are connected, on each side of the vertebral column, merely by a prolongation of peritoneum, which surrounds and suspends them, without fixing them to the spine. There is a manifest relation between the peculiar arrangement, and the great mobility of the column in these animals.

Their form is short and thick in the chelonians, more or less elongated and flattened oval in the saurians and batracians, and extremely elongated in the ophidians. They consist, in the latter, of numerous separate lobes, placed in a chain one before the other. They are also minutely divided in the chelonians, at least on their two surfaces; for all the lobes are united in the centre. They form, on their surface, a kind of convolutions resembling those of the brain, and giving the glands a peculiar aspect.

Among the saurians, the crocodiles have them much divided, at least at a certain age. In a small crocodile, about a foot in length, Cuvier saw no division, while there were many in a larger individual of the same species. It would be singular if this should turn out to be a constant difference, as it is exactly the converse of that which exists in man. They are without lobes, or only slightly divided in other genera of the same order. They have no divisions in the batracians.

The origin of the ureters is analogous to that of birds; and their length varies according to the situation of the kidneys.

They end in the urethra in the chelonians, and the urine passes from that canal into the bladder.

They are short, large, and thick-sided in the crocodile, and pierce the superior surface of the cloaca, at a considerable distance from each other.

The principal ramifications of the urinary canals are easily seen in the ophidians, ending successively, as they come out of each lobe, in a common trunk, which follows the internal edge of the kidney, and forms the ureter. Arriving near the cloaca, each is dilated into a small oval bag, and then terminates separately.

In general they terminate in the cloaca or bladder, according as the latter reservoir exists or not.

Urinary Bladder.—Reptiles vary much in respect to the existence of this part. The chelonian and batracian orders have it: and it is found in the following genera of saurians; viz. the iguana, tapinambis,ameleon, dragon, stellio; while it is wanting in the crocodile, lizard, agame, gecko, other genera of the same order; and in the ophidians.

The bladder is very large, with thin sides and weak muscular fibres in the chelonians; and it has a more or less marked division at its fundus into two portions. A very short urethra opens on the inferior surface of the cloaca: its cavity presents two prominences on each side, of which the anterior is pierced by the orifice of the vas deferens, the posterior by that of the ureter.

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The bladder always receives the urine by its neck, or by a beginning of an urethra, which opens immediately into the cloaca.

There are two large membranous bags in the frog and toad, occupying the situation of the urinary bladder, generally considered as such, and so described by Blumenbach and Cuvier. Townson doubts whether they ought to be considered as part of the urinary apparatus. (See his *Traacts and Observations*, p. 66. tab. 3.) They have no connection with the ureters. Indeed it is very clear, that the latter tubes open on the superior surface; while these two receptacles terminate on the inferior surface of that intestine. They contain a pure water. Their size, which exceeds all ordinary proportion to the bulk of the kidney, renders it likewise probable that they are not receptacles of urine.

Renal Capsules.—The parts to which this name has been given, and which are found in the three first orders of reptiles, are still smaller in proportion, than in mammalia and birds, and are completely separate from the kidneys. In the chelonians they are connected to the emulgent veins. In the saurians and ophidians they lie in the fold of the peritoneum, which unites the ovaries and oviducts.

For a description of the fringed fatty appendices, which are found in the batracian order near the testicles and ovaries, and the vessels of which join the emulgent veins, see the account of the omenta.

Organs of Circulation.—The whole of nutrition is effected at one operation in zoophytes: chyle passes into the parts in proportion as it is made; in insects also it bathes them as soon as it is formed, and they appropriate it. In the superior animals, there is an intermediate operation: a particular fluid only, always moving in a certain system of vessels, immediately nourishes the parts; and this fluid is renewed by the chyle. The motion of this peculiar fluid, of this blood, is called circulation;—a process confined to the superior classes, that is, to the vertebral animals, the mollusca, the worms, and the crustacea.

There are two principal points for our consideration in the circulation; its agents, and the routes of the blood.

That part of the latter is particularly interesting, which conducts the blood to the respiratory organ. One of the chief purposes of the circulation is to conduct the blood constantly, in greater or smaller quantity, into an organ, where it may undergo the mediate or immediate action of oxygen; and, as the qualities of the blood depend much on the degree of force of this action, and in the modification which the blood receives from it, while all parts of the body, being nourished by this blood, partake of its qualities, it follows that the whole nature of an animal will be in some sort determined by the distribution of its circulating organs, and by the route which this distribution marks out for the blood.

Hence arises the importance of the structure of the heart, in reference to natural history, and the correctness of the characters drawn from it for the formation of classes. Men of genius had foreseen, rather than demonstrated this importance; but it has been established on rational principles only in modern times.

The circulations through the body and the lung are called, respectively, the great and the minor. In the former, all the blood returning from the body by the *veins*, which joining together from all parts, ultimately end in one trunk, goes again to these parts by the *arteries*, of which a common trunk is gradually divided and sub-divided, until the last divisions, as well as their union with the roots of the veins, escape the eye.

If the common trunk of the veins communicated directly

with the common arterial trunk, there would be a single circulation; the blood brought back to the centre, would be sent again immediately to the parts, to return again directly, and so on; but this never takes place entirely.

Before the blood, brought back to the common trunk of the veins, can again enter that of the arteries, it must be sent in part, or altogether, to the pulmonary organ, in order to undergo the action of the atmosphere.

If the circulating organs be so arranged that every drop of the blood goes through the lung, by the minor circulation, before it can enter the arterial trunk, the common trunk of the veins of the body sending all its blood into the pulmonary arterial trunk, whose ultimate ramifications communicate with veins united into a common trunk, sending all its blood into that of the arteries of the body, there is a *double circulation*.

If, on the contrary, the common trunk of the general veins, instead of being distributed entirely to the lung, should only send to it a branch, while the rest of its blood should go directly into the common trunk of the general arteries, the minor circulation would be only a fraction of the great, more or less considerable, according to the size of the branch devoted to it. In each circuit of the blood, respiration would be exercised on a part only of this fluid, and the rest would go again into the body by the arteries, without having passed through the lung. This blood, and the parts nourished by it, would participate less, *ceteris paribus*, in the qualities which respiration could impart to it. This is what takes place in reptiles; their pulmonary circulation is only a fraction of the great, more or less considerable in the different genera. The other classes, *viz.* the mammalia, birds, fishes, mollusca, and worms, have a double circulation, and no part of their blood can return into the great, until it has gone through the minor circulation.

Yet we are not to conclude that the ultimate effect of respiration is the same, because circulation is the same. The mode of respiration may be different, and, as this is one of the factors, the product will be affected by its alteration. All the animals last enumerated have an entire pulmonary circulation, while, in reptiles, it is only a fraction: let them be, for example, as 1 to $\frac{1}{2}$. Now fishes, mollusca, and worms, breathing in water, and that oxygen only, which is mixed and contained in this water, may be considered as having a half-respiration, while reptiles, breathing air itself, have an entire one. An entire respiration, multiplied by a half-circulation, and a half-circulation by an entire respiration, give the same product; which is, in both cases, a half-oxygenation of the blood, using this term merely to express the changes taking place from breathing.

Mammalia have an entire circulation and respiration; and consequently an entire oxygenation. The quantity of the latter is even greater in birds in consequence of the peculiar manner in which air is introduced into all parts of their body.

The fraction of $\frac{1}{2}$ is only adopted for the purpose of illustration; the quantity probably varies in the different genera of each class, and cannot be rigorously appreciated.

By these considerations we may estimate, and in a manner calculate, the nature of each animal. As respiration gives to the blood its heat and energy, and through its medium imparts excitability to the organs, its quantity will determine the degree of vigour in the animal functions. Hence we deduce the great force of the moving powers, the acuteness of the senses, the rapidity of digestion, and the heat of the passions in birds. Hence the more moderate degree of all these in the mammalia; hence the inertness, the inactivity, and apparent stupidity, of the other classes. Hence, too, the various modifications of vital temperature natural to

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each of these classes, which are in an exact ratio to the degree of their other qualities.

The circulation is effected by means of muscular powers, which are applied particularly to the arterial system; the venous seeming to be merely passive. A hollow muscle, called a *ventricle*, possessing great and continued irritability, and contracting forcibly on the blood whenever it arrives, is placed at the union of the venous and the corresponding arterial trunk. Valves are placed at its two openings; one valve allows the blood to enter, and prevents it from going back again, while the other permits its exit, and cuts off the return. The ventricle then cannot contract without distending the arteries, pushing forwards the blood, which they contain already, and thus producing the *pulse*. The ventricle, having expelled the blood which irritated it, is relaxed and dilated, and then immediately filled with a fresh quantity of blood from the veins. Before entering the ventricle, the vein is dilated into a muscular sac, called the *auricle*, with much less considerable muscular sides. This is irritated by the blood received from the vein, contracts on it, and sends it into the ventricle. It is hardly necessary to add, that the auricle and ventricle contract alternately.

Animals with a simple circulation have a single ventricle; but they possess sometimes two auricles. When the circulation is double, there may be a ventricle at the origin of each artery, or at that of one only. Mammalia and birds have two, and the *sepia* among the mollusca.

All other animals have a ventricle at the origin of one only of the two arteries, but not of the same in all. It is placed, in fishes, at the origin of the pulmonary artery; in the mollusca at the origin of the artery of the body, or the *aorta*, which is the name of that artery.

The union of the auricle and ventricle constitutes the *heart*. We find, therefore, in fishes and mollusca, a simple heart, *pulmonary* in the former, *aortic* in the latter. Reptiles, also, have a simple heart, at once pulmonary and aortic. Mammalia, birds, and *sepia*, have a double heart, or rather two, a pulmonary and an aortic, hearts.

In mammalia and birds the two hearts are united, and form one mass, which commonly bears the name of heart, as if it were a single organ. This is not the case in the *sepia*. See VERMES, in *Comparative Anatomy*.

We may now understand what naturalists mean, when they say that mammalia and birds have a heart with two auricles and two ventricles; reptiles and fishes a heart with a single auricle and ventricle. The latter phrase, besides comprising, in a common expression, two things really very different, contains also an error of fact; for many reptiles have two auricles.

Respecting the hearts of mammalia, birds, fishes, and mollusca, see the articles MAMMALIA, BIRDS, FISHES, and VERMES, in *Comparative Anatomy*. For the physiology of the circulation, the powers and actions of the heart, and the other organs concerned in it, see CIRCULATION and HEART.

The essential structure of the heart is the same in all animals; there are only modifications of greater or less importance. It is covered externally by a smooth membrane, the reflected portion of the pericardium; its cavities are lined by another smooth membrane, continuous with the linings of the blood-vessels; and there is more or less muscular substance interposed between them. The existence of the pericardium is as general as that of the heart; its nature and disposition are so nearly alike in all animals, that it is not worth while to notice the modifications.

Of the Heart.—In the different orders of reptiles, the heart is found to vary in some parts of its structure; there is,

however, no essential difference, when viewed in relation to its functions. The three first orders have a heart consisting of two auricles and a single ventricle, which is sometimes divided into many cavities, communicating with each other. On the other hand, in the batracians there is but a single auricle and ventricle, with its cavity of a simple form. We shall enumerate successively the differences of structure in the four orders of this class of animals.

First in the chelonians. In the animals composing this order, the heart has a form altogether peculiar. The length of the organ is much exceeded by its breadth; in some instances, it resembles the segment of a sphere; in others, it is of a square but elongated form, and curved in its longitudinal direction. In its natural situation, it is found beneath the lungs, in front of the liver, and partly between the two lobes of the latter. The pericardium, which is capacious and strong, is in contact with the membrane investing those organs, and is as firmly adherent to it as the pericardium is to the diaphragm in man.

The magnitude of the two auricles is much greater in proportion, than in any animals of the classes of mammalia or birds; the capacity of each is at least equal to that of the ventricle; they are situated in part above the latter, projecting upon its lateral and anterior parts. They possess somewhat of a rounded form, are without any appendix, and have their parietes thin, with some fleshy fasciculi in their structure. The right auricle, which exceeds in a trifling degree the size of the left, receives, by a single opening at its upper part, the blood returning from the body. Two valves are placed around the borders of the opening, giving it the appearance of a simple fissure. The pulmonary veins alone terminate in the opposite auricle; their termination is provided in the same manner with two valves. A simple membranous partition separates the cavities of the two auricles and their openings into the ventricle. It is on the ventricle that depends the form which we have described as belonging to the heart. Its cavity is very small in comparison to its size, which is owing to the great thickness of the parietes. These are found to be composed exteriorly of a moderately thick layer of fibres, which have a direction parallel to the external surface of the ventricle. Beneath these, there are other numerous muscular fasciculi, varying in their direction, but proceeding principally from the superior to the inferior surface; the greater number of them are only contiguous, or separated from each other, allowing the blood to pass through the intervals formed between them as through a sponge. It results from this structure, that the cavity of the ventricle is diminished to one-third of its volume; it occupies the middle and right side of its base. In its greater part, it is lined by a continuation of the membranous fold which covers the auricular orifices, performing to them the office of a valve; it is of a square form, attached at the middle of its external surface to the partition between the auricles, and by its superior and inferior sides to the corresponding parietes of the ventricle; it is only loose and unconnected in its right and left borders. The first is extended over the opening of the auricle on the same side, and the latter over that of the opposite auricle; so that these openings appear in the ventricle separated by the breadth of the fold, while in the auricles there is but the thin septum intervening between them. The blood returning from the lungs into the left auricle is directed into the ventricle by means of the valve belonging to the former, in a course directly contrary to that leading to the opening belonging to the arteries of the body. It must, therefore, necessarily pass through the whole cavity of the ventricle, from the left to the right, and

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and into the intervals of the muscular fasciculi composing the parietes. From this structure it results, that there must be an admixture in the ventricle between the blood returning from the lungs, and that portion which has not been submitted to the influence of the surrounding element in its passage through those organs. The opening between the right auricle and the cavity of the ventricle is in a situation immediately directed towards the two cavities leading to the pulmonary arteries and arteries of the body; they are both situated completely to the right, in the cavity of the ventricle. The first, which is not always of the same magnitude, is placed inferiorly to the other, having a wide communication with it. In some instances the opening is extended very far towards the posterior part of the heart; in others it is so small, as in the land tortoises, that it does not exceed the diameter of the cavity leading to it. It is only in the first conformation, of which we find examples in many of the sea tortoises, that the appellation of pulmonary cavity can be applied to it. The blood arriving from the right auricle pursues a direction more particularly towards that part, by a channel leading from the one to the other. There is but one opening leading from the pulmonary cavity, which is that of the pulmonary artery; it is provided with two valves, and penetrates the base of the heart more inwardly than the openings to be next mentioned. These are the terminations of the two aortæ, which are found near to each other on the right side of the superior cavity, the same which receives the blood of the two auricles. The termination of the left aorta is situated a little more inwardly than that of the right, and inferiorly to it. They are each provided with two semicircular valves. This is the structure found in the sea tortoise; but in the land species the arteries of the body arise by a single opening from the ventricle. The heart of the turtle is best delineated by Mery, in the *Acad. des Sciences*, 1703.

In the second order of reptiles, the saurians, we shall commence with a description of the heart of the crocodile, which presents an example of the most complicated structure that we have found in the animals of this order, or even in the whole class of reptiles. The pericardium is found, as in the chelonians, adhering to the peritoneum investing the convex surface of the liver. The apex of the heart is connected by a very strong tendinous chord to the loose part of that bag, which is extremely thick, and has a fibrous structure externally. In its natural situation the organ is found occupying the space between the two lobes of the liver and the lungs on each side. The size of the auricles is somewhat less than in the chelonians; in other respects they are similar. The parietes are strengthened by fleshy fasciculi proceeding in different directions. The ventricle presents an oval form, and has its parietes of great thickness. Its cavity is divided into three compartments, communicating by numerous openings. One of these divisions is situated inferiorly and to the right. The auricle of the same side projects into its anterior part the blood received from the veins of the body by a wide opening, which is provided with two valves. The termination of the left descending aorta is found in the same cavity, in its left and anterior side. Behind this latter opening is seen an orifice, which leads into the smallest of the three divisions, at the middle of the base of the heart, and in which is found the common trunk of the pulmonary arteries. It results from this conformation, that there are two channels offered to the blood which has passed from the right auricle into the cavity of the same side; the one by the left descending aorta; the other into the cavity leading to the pulmonary artery. It may even take a third route, and pass through the numerous

holes which penetrate the partition separating the superior and left cavities. The left auricle projects into the latter the blood received from the pulmonary veins. A membranous valve is found attached to the border of the opening on its right side. The trunk common to the right descending aorta, carotids, and axillary arteries, is situated to the right of the valve. The blood must either pass into the arterial trunk, and from thence be distributed to the head and extremities, or penetrate into the intervals between the fleshy fasciculi of that cavity, and from thence into the two others. It results from this structure, that the blood distributed to the anterior parts by the carotids and axillary arteries, to the posterior parts by the iliacs, and to the tail by the middle sacral artery, is nearly all derived immediately from the lungs, whilst a portion of that which is distributed to the other viscera by the left aorta comes from the right cavity and from the auricle of the same side, and consequently has not been modified by its passage through those organs. The pulmonary blood is not so intimately admixed with that from the body, as in the chelonians. Such is the structure of the heart in the crocodile of the Nile, and the caiman or American alligator. For a view of the crocodile's heart, see Cuvier *Leçons*, t. 5. pl. 45.

It is less complicated in the common iguana (iguana delicatissima). In this animal, the situation of the heart is very remote from the liver, beneath the origin of the lungs, and in the most projecting part of the chest. It is of a conical form, being very broad at its base, and acute at its summit. The auricles present nothing remarkable. In the ventricle, there are but two cavities, the one situated to the right, which forms the proper cavity of the ventricle, the other to the left and superiorly, appearing as a sinus of the former. The openings of the pulmonary auricle and right descending aorta are found in the latter, nearly in the same manner as in the crocodiles. The opening of the right auricle is situated towards the middle of the great cavity or that of the ventricle, and is provided with a femilunar membranous valve, in the same way as that of the left auricle. The orifices of the pulmonary artery and left descending aorta are placed lower down in the same cavity; the first on the left, the other on the right. There is no pulmonary cavity. The interior of the ventricle is furnished with fasciculi of fleshy fibres.

The structure of the heart in the third order of reptiles, the ophidians, differs but in a trifling degree from that of the saurians, possessing the most simple conformation of this organ. There is no distinct pulmonary cavity. The auricles are of considerable size; that which receives the blood from the body is the largest. Their parietes are thin and transparent in the intervals between the fleshy fasciculi, by which their strength is augmented, and which are irregularly interlaced together. Their cavities are separated by a membranous partition. The figure of the ventricle is generally that of an elongated cone, irregularly formed in consequence of an appendix of the same figure, which projects from the left side beyond its base. The interior is divided into two cavities, the one superior, the other inferior, the former being extended into the appendix. An imperfect septum intervenes between them, having a loose unconnected edge on its right side, and is extended horizontally from the base to the apex; it is composed of fleshy fasciculi, allowing the blood to penetrate in their intervals. A considerable opening, by which the two cavities communicate, is found towards the right side of the base of the ventricle, at the part where the septum terminates. The parietes of the ventricle, of themselves moderately thick, afford attachment to a multitude of fleshy fibres, giving additional

additional strength, but greatly diminishing the cavity of the ventricle. These fasciculi are mostly separate from each other, allowing the blood to permeate between them as through a sieve; thus effecting the more perfect admixture between the portion arriving from the lungs and that from the body. The openings of the auricles are found close to each other, at the middle of the base of the heart, above the septum. Each orifice is closed by a semicircular valve of a membranous structure, the loose edge of which corresponds to the auricle of the same side. The termination of the arteries is found in the right side of the base of the organ; that belonging to the pulmonary artery is situated towards the left and in the lower part, corresponding to the inferior cavity. On the left of the latter is found the opening of the left aorta, corresponding to the same cavity, and placed opposite to the opening which forms the communication between the superior and inferior cavity. The opening of the right aorta is found immediately behind the last, and corresponds more particularly to the superior cavity, in which is received both the blood from the lungs and that from the body; the two portions united are projected partly into the right aorta and partly into the inferior cavity, and from thence into the left aorta and pulmonary artery.

In the fourth order of reptiles, the batracians, the heart presents a structure the least complicated of the whole class. It consists of a single auricle of a rounded figure, broader than the base of the organ, with its parietes strengthened by fleshy fasciculi. At the base of the auricle is the orifice of communication with the ventricle, which is single, having a simple cavity, with fleshy columns, not separated from each other. At its base is found the common trunk of the arteries, arising by a single orifice, situated more to the right and lower down in the ventricles than the opening of the auricles. The heart of the frog has been delineated by Swammerdam, *Bibl. Natur. tab. 49*; and by Roefel, *Hist. Ranar.*

Of the Blood-Vessels.—The distribution of the blood-vessels in the four orders of reptiles is varied according to the structure of the heart, and many other circumstances in their organization. In the batracians the arrangement differs in the greatest degree from that of mammalia and birds. All the arteries arise by a single trunk; consequently there is but one opening in the heart. In the three other orders, there are at least two openings, frequently three, which give origin to as many distinct trunks, one of which is destined exclusively to the lungs.

Of the Arteries in the Chelonians.—The arteries of the body arise from the heart by a single or double trunk in different species; those of the lungs by a single trunk. They are firmly connected together for a short distance from their origin. The trunk of the pulmonary artery arises on the left, lower down than that of the body. It quickly separates into two branches, one of which proceeding to the right lung, turns from the left to the right, then advances forwards to arrive at the anterior part of the organ, where the insertion of the bronchus takes place. The other proceeds in a contrary direction, passing across the œsophagus, it arrives at the summit of the left lung.

The trunk of the arteries of the body takes its origin at the right extremity of the base of the heart, and divides almost immediately into two great branches, the right and left posterior aortæ. When the trunk is double at its origin, they separate, forming these two branches. The right aorta furnishes, near its origin, another considerable artery, which may be denominated the anterior aorta. This soon divides into two branches, each of which is again subdivided

into two others, the internal of which, the smallest, is the common carotid, and the external, the subclavian or axillary artery. The common carotid proceeds by the side of the neck, concealed by the muscles going to the os hyoides, sending branches to the œsophagus and adjacent muscles. It arrives at the head, to the parts of which it is ultimately distributed, without dividing previously into two principal branches analogous to the carotids of mammalia. The subclavian or axillary artery furnishes nearly the same branches as the arteries bearing the same name in mammalia, with the exception that there is no branch corresponding to the inferior thyroid. The continuation of the trunk forms the brachial artery. The two posterior aortæ proceed on each side upwards and outwards; then bending backward, they approximate again, and are connected by a communicating branch, which the left aorta gives to the right; nearly opposite to the fifth dorsal vertebra.

The right aorta, previously to communicating with the left, furnishes many arteries to the back or upper shell, corresponding to the intercostals. The left aorta furnishes considerable arteries to the viscera of the abdomen, which consume great part of its blood. When the trunk arrives beyond the cardia, it divides into three branches; the first, which is the smallest, furnishes a branch to the œsophagus, and then is distributed to the stomach. It is analogous to the coronary stomachic of mammalia. The second, almost as considerable as the trunk from which it proceeds, distributes arteries to the intestines, spleen, pancreas, and liver, in the following manner. The hepatic artery is the first given off on the right side; it turns backwards and downwards to arrive at the liver, and divides into two branches, near the base of the viscus, from one of which proceeds a small branch to the pancreas, and numerous others to the duodenum. The second branch is one of small size, and is distributed to the second turn which the colon makes to the right. It is the colica dextra. The third branch passes from the right to the left, and distributes its branches to the transverse colon. It is the colica media. After having given off these branches, the trunk pursues a short course between the layers of the peritoneum, in a direction downwards and backwards. It then distributes the following branches. The pancreatic, which passes from behind forwards upon the left border of the pancreas. The splenic, a very small artery, distributed exclusively to the spleen. A very considerable branch, belonging to all the right part of the colon and cæcum. It is a second colica dextra. A small artery, which, after having given a branch to the cæcum, proceeds to anastomose with the next, the proper mesenteric artery, which is larger than any of the preceding, and ramifies in the mesentery of the small intestine, to which it is ultimately distributed. Lastly, the third branch, resulting from the division of the posterior left aorta, the second in magnitude, proceeds obliquely to the right and backwards, and anastomosing, as has been mentioned, with the right aorta, without furnishing any branch. The common trunk, formed by their union, appears rather as a continuation of the right aorta; it extends along the vertebral column to the pelvis, giving off the following branches in its course. Five or six small branches on each side, corresponding to the intercostal or lumbar arteries. The spermatics. One or two branches on each side to the kidneys. A small artery corresponding to the posterior mesenteric, which is distributed to the cloaca.

The common posterior aortic trunk terminates by four branches, in the individuals belonging to the testudo græca, which we have dissected. The first on the left was the external iliac of that side, then came the internal iliac of the same

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same side, and opposite to it the primitive iliac of the right side. Between the two latter arose the artery of the tail, corresponding to the middle sacral artery. The branches of the internal iliacs are very analogous to the same arteries in mammalia. The trunk divides into two branches; one sending branches to the bladder and cloaca; the other dipping into the pelvis, and corresponding to the ischiatic and posterior iliac arteries. The external iliac proceeds forwards upon the border of the pelvis, furnishes an analogous branch to the epigallric, from which arises the anterior iliac. The first descends upon the internal and inferior parietes of the upper shell, and passes in a direction from behind, forwards. A second branch, which arises from the external iliac, opposite to the epigallric, descends along the anterior border of the pelvis, as far as the symphysis of the pubis, and is lost in the muscles of that part. After having furnished these two arteries, the external iliac passes out of the pelvis, takes the name of crural artery, giving off first the circumflex arteries, then the profunda, and in the rest of its course is analogous to what it is found in mammalia.

The distribution of the principal arterial trunks in the saurians differs but little from that which has been described in the preceding orders.

In the crocodile there are three arterial trunks, each having a distinct opening in the ventricle, provided with two semi-lunar valves. The pulmonary artery, which arises from the cavity bearing the same name, is situate to the left, and somewhat superiorly; the posterior left aorta, which arises from the right and inferior cavity, and is situate between the pulmonary trunk and the next to be mentioned; the posterior right aorta, corresponding to the superior cavity. These three trunks are connected together for a short distance from their origin. From the latter proceed, in the first place, the trunk common to the subclavian and left carotid, which remains attached for some extent to the posterior left aorta, then advances obliquely forwards, passes beneath the bronchus, and divides beyond that canal. Secondly, a similar trunk for the same arteries on the right side. The posterior aorta, after having given off these branches, turns in a direction, first from below upwards, then from before backwards, and divides in a direction obliquely inwards beneath the spinal column, without furnishing any remarkable branch until it receives the communicating branch from the left aorta. This latter turns around the bronchus on its own side, and passes backwards and inwards in the same way as the preceding. After having passed the cardia, it divides into many branches, which proceed to the stomach, spleen, pancreas, and duodenum. These receive the greatest part of the blood of the trunk. The latter has no communication with the right aorta, but by an artery, the diameter of which is scarcely equal to a fourth part of the trunk from which it proceeds.

We have already alluded to the consequences resulting from this arrangement of the arteries, in the description of the heart. All the other arteries derived ordinarily from the abdominal aorta, with the exception of the celiac trunk, here take their origin from the right posterior aorta. It is remarkable that the anterior mesenteric takes its origin at a very considerable distance from the celiac trunk, or from the arteries ordinarily composing it; while, in the chelonians, it most frequently arises very near, or is even a branch derived from it. The splenic is also given off by the celiac. After having passed through the substance of the spleen, from its anterior to its posterior part, and distributed to its substance many small branches which arise at a right angle from the trunk, it passes out almost as large as at its entrance, and proceeds to be distributed to the rec-

tum, and the termination of the small intestine; that branch of the splenic having the latter distribution, forms a considerable communication with the anterior mesenteric.

The pulmonary artery, very soon after its origin, divides into two branches, which proceed to the lungs, in the same manner as in the chelonians. Their diameter is nearly equal to that of the trunks formed by the carotids and subclavians on each side.

In the common iguana, which has the heart placed very far forwards in the chest, the arteries of the body have, in the same manner, two distinct trunks arising from the two cavities of the heart, although they are united at their origin. The left posterior aorta does not furnish any branch before it becomes united to the right. The latter gives origin to the carotids and subclavians, as in the crocodiles; but with this difference, that the latter do not arise from the same part as the former, but much farther backwards, on account of the heart being placed so much anteriorly.

In the lizards properly so called, the two aortæ advance forwards out of the chest; the right having first divided into three branches, the left without forming any division. The latter turns backwards upon the sides of the neck, to proceed afterwards along the vertebral column; and at the point where it takes a direction from before backwards, it receives the left branch of the right aorta, which forms a curvature in front of it. From its convexity arises the left carotid. The two other branches of the right aorta turn backwards, and unite in the same manner on the right side of the neck, forming two arches in front of each other. The carotid of the same side arises in a similar manner from the anterior arch, formed by the middle branch. The subclavians arise from each aorta a little before their junction. We have seen that in the crocodiles and the common iguana, they are produced both by the right aorta. The trunk formed by the union of the two arteries, which unite speedily after their origin from the heart, produces the different pairs of intercostal arteries in succession. It gives off, near its commencement, an artery to the œsophagus; farther on, a small artery which proceeds to the liver; and still farther, an artery which quickly divides into two branches; the anterior of which distributes its ramifications to the stomach, spleen, pancreas, and duodenum. The posterior belonging to the intestinal canal is properly the anterior mesenteric. From the trunk the following arteries next proceed: the lumbar, the spermatics, the posterior mesenteric, which proceeds immediately to the rectum, the renal, which are among the last given off, since the kidneys are situate very far back in the abdominal cavity. Lastly, it produces the iliacs and middle sacral artery. The latter is of so considerable a size, that it may be regarded as a continuation of the aortic trunk, of which the iliacs appear only as branches. This circumstance evidently depends on the great size of the tail, in comparison with the extremities.

The distribution of the principal arterial trunks in the third order of reptiles, the Ophidians, becomes much simplified from the deficiency of extremities, and there being but a single lung. The number of the trunks is the same; the relations between their openings in the heart have been already mentioned in the description of that organ. The pulmonary artery ascends and turns backwards upon the base of the heart, and speedily arrives at the inferior surface of the lung, where it passes from before, backwards to the left of the vein. The right aorta ascends on the same side, bends backwards, passes above the œsophagus, and obliquely backwards and inwards, to join itself to the left aorta, some distance beyond the point of the heart. It gives off, near its origin, some small arteries, which proceed to an orbicular

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orbicular gland, placed in front of the base of the heart, likewise to another gland of a more considerable size and elongated form, situate beneath the jugular. The trunk then furnishes the common carotid, the only one existing in this order of reptiles. It passes obliquely to the left, and advances, by the side of the left jugular, between the trachea and the œsophagus, and lastly beneath the latter. It sends a great number of ramifications to these organs, and divides near the head into many branches distributed to the adjacent parts. Near to the vertebral column, the right aorta produces a considerable branch corresponding to the vertebrals and superior intercostals which proceeds along the spine, sending to it branches, and wholly penetrating into it near the head. When the communication takes place between the right and left aorta, the diameter of the former is become very small, so that the greatest part of the blood which it has received from the heart is distributed to the parts in front of that viscus: it is properly the anterior aorta. The left aorta ascends and turns backwards to the left, passes beneath the œsophagus; then by the side of and always beneath the lung, receiving the right aorta beyond the heart; and continuing to pass in a direction backwards, it gives off branches corresponding to the intercostals, likewise arteries to the viscera. Those branches proceeding to the stomach, pulmonary bladder, and liver, are detached successively from the aorta, as it proceeds backwards; thus there is no celiac trunk. Nearly opposite to the pylorus, the aorta furnishes the anterior mesenteric, which proceeds parallel to the intestinal canal one half of its extent, sending to it branches. Farther backwards the intestinal canal receives three other small branches in succession, from the same artery: as it passes backwards, it also sends similar branches to the kidneys, ovaries, &c.; arrived at the lower part of the abdomen, it penetrates beneath the vertebræ of the tail and is lost in that part.

In the last order of reptiles, the *Batrachians*, the aorta, which proceeds from the base of the ventricle, soon divides into two branches, which separate and pursue a very oblique direction from within, upwards and a little forwards. Each branch gives off a pulmonary artery, a common carotid, an axillary, a vertebral, and arteries corresponding to the intercostals; then turning backwards, and approaching its fellow, it speedily becomes united to it. The trunk formed by their junction gives off, first, the celiac trunk, then all the other arteries which arise ordinarily from the abdominal aorta, presenting nothing worthy of remark.

Of the Veins.—In the *Chelonians* there are two posterior venæ cavæ, which pass through the liver on each side, and receive in their course numerous small hepatic veins. Immediately after their exit from the liver, they are joined by two anterior venæ cavæ, one on each side, or by the common trunk of the jugular and subclavian. They all terminate in the right auricle by an opening in the form of a fissure, provided with two valves; they do not terminate in the cavity of the auricle, but in a receptacle communicating with it. The pulmonary veins united in a single trunk terminate in an analogous receptacle, which opens into the left auricle; around the borders of the opening, there is placed a fleshy valve in the form of a half moon.

In the *Saurians* and *Ophidians*, there is but one posterior vena cava, and two anterior, that belonging to the left side passes across, and above the heart, in a direction from left to right, and terminates in the common receptacle by the side of the posterior vena cava. This receptacle, similar to that found in the chelonians, has in the same manner its entrance into the right auricle, in the form of a fissure,

and provided with two valves. In this order, likewise, the anterior venæ cavæ are more properly considered as the jugulars. They have also a double azygos, one formed by the intercostal veins in front of the heart, the other posterior to it. They both join the right auricle by the side of the right jugular. It appears that they are rendered necessary by the situation of the venæ cavæ, which is very remote from the vertebral column, and more inferiorly.

The pulmonary veins in the *Saurians* are similar to those of the *Chelonians*.

In the *Ophidian* order there is only one, which terminates in the same manner in the left auricle. Its volume exceeds that of the artery, which we have not observed in the other reptiles.

In the *Batrachians* the veins have a distribution similar to that of the arteries which results from their terminating in a single auricle, in the same way as the latter arise from a single ventricle. There are two anterior venæ cavæ which receive the blood from the head, neck, anterior extremities, and from the veins analogous to the external mammary, which are very considerable, extending beneath the skin to the groins, and likewise a posterior vena cava, which receives the veins from the other parts, presenting nothing worthy observation.

The blood-vessels of the tadpole are described in the account of that creature in the division concerning the generative functions; and those of the proteus and firen, in the separate description of those animals at the end of this article.

Physiology of the Circulating Organs.—The nature of the blood in reptiles, the points in which it differs from the corresponding fluid in other classes, its difference in the various orders and genera, its relations to the food and to the secretions and excretions, are so many interesting topics of inquiry, on which we have absolutely no information to offer. Chemistry does not yet appear to be sufficiently advanced for the successful investigation of these and similar matters.

We may observe, in the first place, that the reptiles of these climates at least, possess, in comparison with warm-blooded animals, a much smaller quantity of blood in proportion to their size: hence their muscles are whiter, and some of their viscera, particularly the lungs, which are loaded and gorged with such a profusion of blood in the warm animals, present in this respect an appearance altogether contrary in reptiles.

"I made an experiment," says Blumenbach, "on the water salamander, (*Iacerta lacustris*, L.) of which I dissected twenty-four, adult, lively, recently taken in the early spring, and weighing together $1\frac{1}{2}$ ounce, in order to measure the quantity of blood they contained: I could preserve from the whole of the bodies of all, only two scruples and a half. This small quantity of blood is to the whole body as $2\frac{1}{2}$ to 36; while in an adult and healthy man the proportions are calculated at 1 to 5. Hasselquist observed the same circumstance of the small quantity of blood in proportion to the body, in the crocodile of the Nile." *Voyage dans le Levant & en Palestine.*

It is also remarkable, that the arterial blood of our reptiles differs in external appearance in the smallest degree, if at all, from the venous, so that one can be distinguished from the other only by the situation and course of the vessels; while, on the contrary, the bright scarlet arterial blood of the mammalia offers so remarkable a contrast to the dark livid or purple venous fluid; unless when they have been for some time in a warm bath or other warm medium, when it appears from the elegant experiments of Dr. Crawford,

ford, that the venous blood, becoming gradually less and less dark coloured, approaches more nearly to the vivid redness of the arterial stream. (See *Philos. Transact.* v. 71. p. 487.) Haller observed that there is no difference between the arterial and venous blood in the frog. (*Oper. minor.* v. 1. p. 183.) And Spallanzani noticed the same fact in the salamander or water newt: "avutasi egualità di diametro, il colore del sangue venoso e somigliantissimo al colore del sangue arterioso." De' fenomeni della circolazione, pag. 100. And again, "il sangue arterioso in nulla differisce dal venoso, sia nel colore, sia nella densità." P. 193.

In this circumstance reptiles resemble the fœtus of warm-blooded animals; in which, so long as it remains immersed in its uterine bath, we know that the arterial and venous bloods are of the same colour.

Yet all animals of this class are not alike in this respect. Accurate observers have asserted, that in the tortoise the venous blood is black, and the arterial crimson, as in the warm-blooded classes. (Caldesi, *Osservazioni Anatomiche intorno alle Tartarughe*, p. 60. Mery, *Hist. de l'Acad. des Sci. de Paris*, 1669. v. 2. p. 210.) This difference probably corresponds with the diversity of structure observable in the respiratory organs, which are calculated, in the different orders of reptiles, to admit of a more or less intimate exposure of the blood to the air in respiration.

The colour of the blood varies in our amphibia according to the state of their nutritive functions: it is paler when they have fasted, of a deeper red when they have been well fed. If, under the latter circumstance, it be drawn from a vein, and exposed to the air, it exhibits a bright florid redness as it forms the coagulum.

The component elements of the blood of amphibia, considered in a general way, seem nearly to resemble those of the warm-blooded animals, except that in the former, when examined alive, there are almost always seen bubbles of air mixed with their purple stream, performing, like the blood itself, the circulation, and dividing that fluid in the vessels into intervals, as the mercury is interrupted in a badly made thermometer. Redi and Perrault observed this fact in tortoises; Jacobæus in serpents; Dauid in the green lizard, frog, and salamander (*Hist. Nat. des Reptiles*, *Introd.* p. 184.); and Blumenbach in the amphibia of Germany. Now, although in certain states the veins may be very turgid, and elastic air may be found in them after death, nothing of this kind is ever known to take place in a healthy and strong individual. The air indeed is supposed in the mammalia to constitute one-thirtieth of the blood, but it is so dissolved, and so intimately mixed in the vital stream, that it can only be extricated and exhibited in its elastic aerial form by artificial means.

The phenomena of the circulation are common on the whole to the reptiles with the warm-blooded animals, and are very familiar in the former, since the wonderful circulating motion of the blood was not only first actually seen and described in frogs by the great Malpighi, but is also still examined to the present time in those animals. The branchiæ of the tadpole are very favourable objects for investigations of this kind.

As the circulation can be actually seen in these animals, we may inquire on this subject, whether the globules of the blood, entering the minute vessels, can be really observed to change their figure, and become oval instead of spherical. "In warm-blooded animals," says Blumenbach, "I have never heard or read that any one has seen such a change; and I certainly have never seen, either in the incubated chick, in which the circulation of warm blood may be most clearly and beautifully observed, particularly on the fifth and

following days, or in the frog or lizard, any oval globules: yet Reichel asserts that he has seen globules changed from spherical to oval in the mesentery of the frog, and has given an elegant plate in illustration of the fact. See *Experimenta de Sanguine ejusque motu*, fig. 3." Blumenb. *Specimen Physiol.* p. 10. He doubts, however, whether this change can be considered as a natural occurrence in the healthy circulation, or ought to be referred to the disturbance naturally following the sufferings of the animal.

The motions of the heart, consisting in our amphibia of a single auricle and ventricle, agree in the alternate contractions and relaxations of those parts, with the analogous succession of systolic and diastolic changes observable in the double auricles and ventricles of the warm-blooded classes.

A question was formerly raised, concerning this systole or contraction, whether the ventricles are really shortened, or experience merely a diminution of diameter? The former, says Blumenbach, has now been proved by the most careful observations both in cold and warm-blooded animals; he adds, that he has never seen it demonstrated more clearly, and beyond every suspicion of inaccuracy or mistake, than in the common snake (*coluber natrix*), in specimens of which, two yards long, from the woods of Germany, he has observed, and frequently demonstrated, a shortening of the ventricle equal to two lines. Blumenbach states further, that the ventricle is completely emptied in its systole, not the least drop of blood flowing back into it from the aorta, in the snake, frog, and toad, and also in the incubated chicken. But he does not venture to decide, whether the same thing occurs in man and the other mammalia, or whether the semilunar valves may intercept some drops of blood, which thus are made to flow back into the ventricle.

Reproduction.—As the nutrition and growth of parts, in the healthy state, are among the most important functions of the blood-vessels, so the reparation of injury, and the restoration of what is mutilated, constitute another very striking instance of their powers, and a very impressive example of those prerogatives, which belong exclusively to living organized beings. Although this power of reproduction, taken in its most extensive acceptation, cannot be said to be withheld entirely from any animal, several genera of reptiles possess it in a more remarkable degree than any of the other vertebral classes. There is an interesting account in the *Memoirs de l'Acad. des Sciences de Paris*, 1686, particularly of the restoration of the tail of lizards. Spallanzani, Bonnet, and Blumenbach, have employed themselves in researches on this subject. The former first called the attention of the public to it in his "*Prodromo di un' Opera da imprimerfi sopra le Riproduzioni Animali.*" Bonnet published his memoir on the reproduction of the limbs of the water newt in the *Journal de Physique*, 1777. His enquiries were again published in his "*Cœuvres d'Histoire Naturelle*," t. 5. and there are three memoirs by him on the subject, translated into English, in Spallanzani's "*Traacts on the Natural History of Animals and Vegetables*," v. ii. The experiments of Blumenbach are contained in his "*Specimen Physiologiæ comparatæ.*" The experiments have been made chiefly with the water newt; on the *lacerta agilis* of the terrestrial kind, see P. T. Hartmann, *de generatione viviparorum ex ovo*, p. 26; respecting the lizards of the Antilles, see Oldendorp *Geschichte der Caraibischen Mission*, p. 97.

"It might be supposed," says Bonnet, "that the amputation of the limbs is most painful, and that the animals would suffer long and severely from it; however, one of my observations apparently infers the reverse. I cut the left

hand and the right foot off a large newt; and a stream of blood, as thick as a hog's bristle, continued spouting out nearly two minutes without intermission. Not only did the animal seem not in the least enfeebled by the loss of blood, but, in scarcely a quarter of an hour, to my great surprize, it swallowed two earth-worms." Spallanzani's *Tracts*, v. ii. p. 367.

The following narrative is extracted as a specimen of Bonnet's experiments. "On the 6th of June I cut off the right arm and left leg of a large newt close to the body. (It seems from the accompanying figure that the sections passed through the femur and humerus respectively.) A stream of florid blood spouted a minute and a half from each wound; however, the vessels soon closed, and the newt was apparently as well as those unamputated. But it will easily occur, that it did not swim with equal facility. When about a month had elapsed, I began to perceive a papilla, of a violet grey colour, near the edge of the trunk or section. This was the origin of a new arm and leg, which gradually increased, and were quite perceptible, although still very small, on the 14th of July. The two papillæ grew more in length than in thickness: they became minute stumps, and on the 1st of August were two lines long. A kind of cleft hardly perceptible announces the appearance of two toes: no cleft appears on the originating arm. The new parts were very distinguishable from the old by their lighter colour. The two toes were easily recognised on the seventh: they were real miniatures, and truly most minute. The stump of the arm had increased, but there was no indication of fingers.

"It is pleasing to observe the little hand fully unfolding, while only three fingers of unequal length are visible: the middle one is the longest. The arm has made no sensible progress. The new foot had four toes also of unequal length; the first and second of which are longest; the other two only begin to appear; the fourth is scarcely perceptible. Evolution advanced every day. The regenerated members began to deepen in colour, so that the line, discriminating the old parts from the new, was no longer so conspicuous; but the black specks on the toes of unamputated newts were still imperceptible. On the 22d of August four well-shaped fingers were already on the hand; but only four toes out of the five which the foot regenerates; and they all have to acquire more size, confidence, and colour. I continued my observations on the daily evolutions of the members; and the following were their dimensions in length on the 30th of September.

Old Members.		New Members.	
Arm	- 4 lines.	Arm	- 2½ lines.
Cubit	- 3½	Cubit	- 2½
Thigh	- 3	Thigh	- 2½
Leg	- 4	Leg	- 2½
Longest finger	- 3½	Longest finger	- 1½
Longest toe	- 4½	Longest toe	- 1½

Even in the beginning of October, the fifth toe of the new foot was not visible." *Lib. cit.* 372, et seq.

There is a kind of semi-transparency in the reproduced parts, which the original members have not. This continues long, and changes slowly as the reproductions colour. The transparency is evidently greater on the edges of the fingers than elsewhere; if examined with a magnifier they seem inclosed in a fine diaphanous envelope: but nothing of this is evident in the old fingers. (P. 376.) "It is incredible how long the new fingers require to attain the size of the old. I have had newts, whose fingers, in thirteen months and more, were not as large as those of unamputated members."

(P. 393.) "When the tails of large newts were amputated near their origin, the whole died in a certain time. If the part be cut off about its middle, reproduction will follow. A tail was cut on the 11th of July, and on the 14th of August, the reproduced part was about three lines and a half long, and four and a half in diameter at the base. The new portion was ten lines in length on the 20th of September, and shaped exactly like the tail of a newt. I could observe no difference between the motions of this regenerated tail, and those of tails unamputated. On the 8th of October the regenerated part had a peculiar transparency, wanting in the rest of the tail." P. 381, et seq.

"The fingers and toes are not evolved in the same proportion as the arm and leg. Now, when I write this, on the 10th of October, the new arm and leg of the newt, mutilated on the 6th of June, have nearly attained the size of the original members, while the regenerated fingers and toes have not acquired half their natural size; yet they are perfectly well formed, and execute all their functions." P. 390.

Blumenbach found that the true salamander (*Iacerta salamandra*) possesses the same reproductive power as the water newt (*Iacerta lacustris*): that a third part of the tail, or a toe, would be perfectly but very slowly reproduced, and remained even at the end of a year considerably inferior in size to that of the original parts. Specimen, p. 32.

Bonnet made other experiments to determine whether reproduced members possess the same powers of reproduction as those amputated. He cut off an arm and a thigh of a large newt on the 2d of June: as soon as the hand and foot were visible, he cut them off, and they were renewed: he repeated this four times, the last operation being on the 13th of October, and the parts were each time restored. P. 394, et seq.

He dislocated the arms of one and the thighs of another newt, so that the members immediately after were pendent, as if dead, the animal having no power over them. On the following evening each newt moved the disjointed limbs with a liberty and facility which announced that nature had already repaired the disorder. P. 431.

The most surprising fact in Bonnet's Memoir is the reproduction of the entire eye. "With a scalpel," says he, "I extracted the right eye of a large newt on the 13th of September, 1779; but I did not obtain the globe without much injury to the tunics. A deep bloody wound in the socket of the eye was the consequence of this cruel operation. And the reader will not be surprized if I hardly expected any thing from it, and that the newt would probably remain blind for ever. How great was my astonishment, therefore, when, on the 31st of May, 1780, I saw a new eye formed by nature. The iris and cornea were already well shaped, but the latter wanted its peculiar transparency, which is very considerable in these animals. The restoration was complete on the 1st of September; the cornea being transparent, and the iris having acquired its yellow gilded colour. On the 8th of November 1780, it differed from the other eye only in being a little smaller, and in the iris, or golden circle, going only half round the ball." P. 432, et seq.

"I repeated," says Blumenbach, "the experiments of the celebrated Bonnet, concerning the reproduction of the eye in the water newt. I cut out the whole globe, at the insertion of the optic nerve, in three instances, in neither of which was the organ reproduced: but a white and firm fungus, shooting from the cut end of the nerve, gradually filled the orbit, the animals themselves becoming affected with a kind of dropical swelling, and dying in a few

few months. Instructed by these failures, I proceeded to operate in a different way on a fourth animal, in May 1784. I first divided the cornea, to let out the lens and other humours, and then cut away the remaining empty and collapsed coats, leaving a small portion of the common coverings of the bulb, which, from a careful examination in water with a glass of the parts removed, I judge to have been scarcely equal to one-fifth of the whole globe. In the following months the whole orbit seemed closed by the approximated eye-lids, which, however, began to separate in the sixth month after the operation, and thus disclosed a new little bulb springing up from the bottom of the orbit. This new globe was still much smaller than the other in April 1785, when the animal died accidentally, though in other respects it was most perfect, exhibiting the golden iris with its regular pupillar aperture behind the cornea, all which points are clearly distinguishable in the preparation which I preserve." Specimen, p. 31.

"On comparing," says the author last quoted, "the facts just detailed with the very limited and much less perfect reproduction observable in warm-blooded animals, we shall become sensible of the wide difference between them and the amphibia. I am daily more and more convinced, that no parts are reproduced in man and the other mammalia, except such as are composed merely of cellular substance, and enjoy no other kind of vital power except common contractility; and I cannot find sufficient proof that the irritable muscular fibre, the sensible nervous medulla, or those parenchymata which are endowed with a peculiar modification of vitality, have ever been truly reproduced in a warm-blooded animal." Ibid. p. 32.

Tenacity of Life.—This subject is so far analogous to that which we have just considered, that we pass naturally from the view of the facts, in which the surprising reproductive powers of the class is evidenced, to the no less astonishing examples of their very hardy vitality; of the energy and permanence of their vital forces, both in individual parts, and in the body at large.

The amputated tails of water newts, and the divided fragments of the blind-worm (*anguis fragilis*), exhibit very lively motions for ten hours and more. The heart of a frog or serpent continues to palpitate on irritation many hours after its separation from the body; and the limbs of frogs are excitable by the Galvanic influence for a long time. Some reptiles, as the serpents and testudines, can open and shut the mouth long after the head has been severed from the trunk. General Gage informed Blumenbach that he had seen the amputated head of a rattlesnake bite long after its separation: and another British officer stated to him that when he put a stick between the jaws of an American turtle, the second day after decapitation, it was firmly held.

The same energy of the vital force in the parts, and the independence of one class of functions on another, in the amphibia, are further evinced by many well known facts; the limbs of turtles have moved for eleven days, nay, on the thirteenth day after decapitation (*Güldenstaedt, Theoria virium corp. hum. primitivarum*, p. 74.); and a rattlesnake lived some days after the skin had been removed, and most of the viscera taken away. Tyfon, in *Philosophical Transactions*, N^o 144.

In the beginning of November, Redi opened the skull of a land tortoise, and removed the whole brain. The animal did not seem to suffer, it moved about as before, but groping its way; for the eyes soon shut after losing the brain, and never opened again, a fleshy integument formed,

which covered the opening of the skull, and in this state the animal lived till May. Spallanzani deprived four frogs of the brain; two lived till the fifth day. He also deprived three newts of the brain; they suffered violent convulsions; their eyes closed, they hardly moved from one place to another; and expired about the middle of the third day. He cut the heart out of three newts; they took to flight, leapt, swam, and executed the same functions as before; however, all died in forty-eight hours. Four frogs, deprived of the heart, kept their eyes open, and preserved the use of their limbs. They survived thirty-six hours. Spallanzani's *Tracts*, Introduction, p. 45.

Captain Cook met with a turtle, in which there was a wooden harpoon about fifteen inches long, and barbed, between the shoulders. The opening by which it had entered was quite healed.

Redi and Boyle saw some signs of life in serpents after they had been twenty-four hours in *vacuo*. And they will live more than four hours in spirits of wine. See Daudin, v. 6. p. 100; and v. 1. p. 270.

In our account of the physiology of the digestive organs, we have already noticed the singular power which reptiles possess of remaining for such long periods without food. They are equally remarkable for being able to bear, permanently, considerable degrees of heat and cold. Not only are most of the Class inhabitants of the warmest regions, but some of them, like some fishes, are known to live in warm springs, inhabiting them spontaneously, and appearing to be healthy. (See Cocchi in Spallanzani, *Opuscoli di fisica animale e vegetabile*, v. 1. p. 46.) They live in the warm springs of Pisa, which rise to 37° of Reaumur, 115° of Fahr.

"Besides a host of suspicious narratives," says Blumenbach, "of newts, and other amphibia, which have lived for a considerable time in the human body, there are many unexceptionable and indubitable examples of this remarkable phenomenon." See the narrative of Th. Reinesius, a most respectable authority, concerning a girl of Altenburg, in Bartholin, *Act. Havniens.* v. 2. p. 110; Harder, *Apiar. observat.* p. 89; I. R. Zwinger in *Act. Helvet.* v. 1. p. 22; *Hist. de l'Acad. des Sciences de Berlin*, 1770, p. 40; a mass of citations in Jacobæus de ranis et lacertis, p. 12; Paulini de Bufone, p. 38; I. Helwig *Observ.* p. 249 and 272; Kundmann *Promptuarium*, p. 108; also *Act. Natur. Curios.*; *Collectan. Vratislaviens. et Commenc. Literar. Noric. &c.* These facts are not so remarkable on account of the degree of heat to which the animal is exposed, as from the other concomitant circumstances. We must observe, however, that these animals inhabited the stomach so long as they continued alive, while the individuals troubled by these unusual guests were led, by their suffering, to drink copiously of water, and thus in a manner supplied the newts with their natural element.

"Reptiles have the power of bearing intense cold as well as great heat. I one morning found a tree-frog, which I had kept for some time, in consequence of a frost suddenly set in the preceding night so as to reduce the thermometer to 30° Fahr., completely inclosed in a cake of ice, like insects in amber; of course it was motionless, the eye-lids shut, &c. As the ice melted, the animal recovered, first moving its hind legs, when they were disengaged; the head and trunk still being most firmly detained; when the solution was complete, the whole animal was restored, seemed as well as before, and survived a long time. Du Fay attests the same circumstance concerning water newts; *Mém. de l'Acad. des Sciences de Paris*, 1729, p. 144. The amphibia are exposed to be frozen in their winter sleep; but we are the less

surprised at the occurrence, because all the functions are either entirely suspended, or most languidly performed." Specimen, p. 10.

Organs of Respiration.—After describing the heart, and viewing the phenomena of the circulation, we proceed to the lungs, which are not only most important parts in the economy of all animals that possess blood, but constitute, in the peculiarity of their structure and functions, the most striking marks of distinction between reptiles and warm-blooded animals.

All reptiles breathe by means of lungs, which in their bulk considerably exceed those of the mammalia, while the latter are as far superior in the abundance of their vascular ramifications, and the wonderful minuteness of their internal subdivisions. These large, but loose and rare vesicular lungs, are contained, not in a particular cavity, separated from the abdomen by a diaphragm, but, with the other viscera, in a general cavity of the body. Hence the mode of respiration is as different from that of the mammalia, as the texture of the organ.

To the general position, that reptiles breathe by means of lungs, there is an exception in the batracian order; in some of which (the proteus and firen) there are branchial appendages or gills, as well as lungs; while in the first state (the tadpole) of others, there is a similar conjunction of these two modifications of respiratory apparatus. See the anatomy of the tadpole, in the account of the generative organs, and that of the firen and proteus, at the end of this article.

The Air-tubes.—The trachea is not divided into bronchi in the ophidian order, which have a single lung; neither does this division take place in the green lizard (*Iacerta agilis*), whose trachea, having reached the united anterior extremities of the two lungs, opens into each by a large orifice: but it is found in almost all the other animals of this class. The division is effected very early in the chelonians, which have consequently a very short trachea, and long bronchi; more particularly because the latter, instead of entering the lungs directly, first make a turn in the chest. The trachea is divided much later in the crocodile, where the tube is bent from behind forwards, divided into bronchi, which also run forwards, and then turn from before backwards, remaining for some time joined to each other. The bronchi are extremely short in most other reptiles: they begin, in the batracians, immediately below the larynx.

Reaching the lungs, the bronchi generally terminate abruptly by one or more large orifices, which open into the cavities of these viscera. This is what occurs in the ophidians; but in the chelonians and the crocodile, each bronchus is continued into the interior of its lung, before it terminates. They are continued, in the testudo græca, into the most remote part of the lung, without undergoing any sensible change of diameter; and they communicate with the large cells composing these viscera, by ten or twelve wide orifices, of which the outlines are circular, like the commencement of canals. In the turtles, each bronchus penetrates in like manner to the farthest part of the lung, but gradually diminishing in diameter. Their sides are pierced with numerous holes, opening into the pulmonary cells.

The relative size of the trachea and bronchi does not exceed what we observe in the mammalia and birds, except in the ophidians, where the diameter of the former is very considerable. These air-tubes never exhibit any inequalities, such as are seen in birds.

They are generally composed of complete cartilaginous rings, and consequently are little susceptible of changes in size. We must, however, except the crocodile, in which

animal the front end of the trachea presents, on its upper surface, a membranous interval, which is wider the nearer we come to the larynx; (see Humboldt *Recueil d'Observations*, &c. tom. i. p. 11. of the crocodile of the Orinoco; and Geoffroy in *Annales du Museum*, tom. ii. of the Nilotic species); the cameleon, where the annuli are incomplete in the last portion of the trachea, and at its bifurcation; and the ophidians, in whom the trachea possesses cartilages only in one third of its circumference. These cartilages are also visible for a short space along the front end of the lung, in a groove of its inferior surface, containing also the pulmonary vein. The trachea, however, ceases suddenly on touching the lung, and dilates immediately to form its sac.

In those reptiles which have bronchi running throughout the length of the lungs, the portion of the tube, contained in these viscera, has only imperfect and irregular pieces of cartilage, which nevertheless surround its circumference. They are more thinly scattered in the turtles, in proportion as we observe them farther back in the lung.

This cartilaginous structure of the air-tubes (the trachea and bronchi) of reptiles, renders them very incapable of changing their diameter. They seem entirely destitute of transverse muscular fibres; nor do we perceive any longitudinal ones to diminish their length. The membranous trachea of the ophidians, possessing cartilages only in the inferior third of its circumference, seems equally destitute of muscular fibres. On this membrane we discover a fine white and opaque net-work, which is continued into the interior of the lung, where its meshes, as we shall see, border the cells, and are formed of stronger threads, apparently of a tendinous structure, and perhaps capable of contraction.

Vesicular Structure of the Lungs.—We have mentioned that the lungs of reptiles are very large: they are immense in the testudines and cameleon, and are even considerable in the native amphibia of these climates, if you compare their relative bulk to that which they possess in warm-blooded animals. We have just seen that the bronchi do not divide, that they do not usually enter the lungs, but terminate abruptly by one or more large orifices, as soon as they have reached these viscera. In the batracians and saurians, the lungs form two sacs, varying considerably in their form and relative size, and having their internal surface divided by membranous plates into polygonal cells, in which other smaller plates form more minute divisions. They have been justly enough compared by Blumenbach to the reticulated structure, in the second stomach of ruminating animals. These cells are more numerous, smaller, and deeper in the anterior part of the sac: they become more open towards the posterior part; and when the latter terminates in one or more appendages, we see only a net-work, with loose and extremely fine meshes. Afterwards the parietes of the pulmonary sac are quite simple, and without any division. Such is the structure in the appendices which terminate posteriorly the lungs of the cameleon, and the agame or *Iacerta marmorata*; and of the great bladder in which the single lung of the ophidian order ends.

The lungs of the salamander, the proteus, and firen, form also simple sacs without any division.

"In frogs and toads," says Blumenbach, "the lungs are made up of polyhedral and large cells: the same structure is observed in the *Iacerta agilis* and salamander. They form an oblong bladder in the aquatic *Iacerta* (water newts). The lung of the coluber natrix forms a single bag of large size, hollow throughout; and the same structure seems, from the reports of anatomists, to exist in other serpents. (See Coiter *Obs. Anat. Chir.* p. 126. Charas

Nouvelles Obs. sur la Vipère, p. 39. Tyson in Phil. Trans. N° 144. p. 30. tab. 1. fig. 1. tab. 2. fig. 4. Seba Thefaur. vol. ii. tab. 109. fig. 1—5.) The pulmonary bag of this coluber exceeds a Paris foot in length. Rather more than the anterior half has thick sides, with an elegantly reticulated internal surface, resembling in its general habit that of the internal surface of the second stomach of the ruminating mammalia. The remaining posterior portion is a simple thin membranous bladder." Specimen, p. 12.

The structure is rather more complicated in the chelonian order. Each of the openings of the bronchus, which we have stated to be about ten or twelve in the testudo græca, is the entrance of a particular sac, the sides of which are composed of polygonal cells, in which there are still smaller ones. Each of these cells is bordered by whitish and as it were tendinous chords, which appear designed to support their sides, and fix the sacs to the orifices of the bronchus. The sacs or principal cells are much smaller, and more numerous, in the turtles, and correspond to the numerous orifices with which the bronchus is pierced. We see also the cords forming and supporting the cells, and giving to the lungs of those animals the appearance of a cavernous tissue.

The form and size of the pulmonary cells may be somewhat different in the crocodile, but their essential structure is the same. In this respect the crocodiles depart from the lizards, and approach the turtle and tortoise. Geoffroy in Annales du Muséum, vol. ii. p. 46.

How different a notion do these details convey to us, of the structure of the lungs in reptiles, from that which they possess in the warm-blooded classes! Although they may be described in the latter as cellular, spongy, and light, yet, when compared to the same organs in the former class, they are vastly more compact, made up throughout of an infinite number of ramified air-tubes, and of countless most minute bronchial cells connected to them, united and interwoven with common cellular tissue. Hence, if we compare any mammiferous animal with a reptile of the same size, as the vespertilio murinus with the rana bombina, the lungs of the latter are indeed the largest, but are beyond all comparison inferior to those of the former in the very inconsiderable number of their cells.

As the lungs of warm-blooded animals so wonderfully surpass those of reptiles, in the minuteness and number of their cells; so they still farther excel them in the astonishing abundance of their blood-vessels. The simple appearance of the organs, without any anatomical preparation, is sufficient to shew this fact; and microscopical examination, after successful injection, fully confirms it. For, although the lungs of the amphibia exhibit their dense vascular networks, beautifully painting the sides of the cells, these are not to be compared to the number and subtilty of the ramifications, eluding even the assisted eye, which every where fill up the lungs of warm-blooded animals.

Since, in the mammalia and birds, all the blood of the body must pass through the lungs, before it can return again to the organs, it was necessary to have a large number of vessels for its conveyance, and a surface for their expansion, both extensive on account of their number, and the necessity of exposing the blood in minute portions to the air, and yet confined as much as possible to one spot, that its bulk might not be inconvenient. Thus we explain that inextricable tangle of blood and air-vessels, and small vesicles or cells, which compose the lungs of mammalia and birds. All these circumstances are different in reptiles. If we may judge from the diameter of the pulmonary arteries, they receive at most a third of the circulating mass, and sometimes much less. It is not necessary that this blood should

pass back again through the lungs to return to the body: it may proceed by another route, as we have explained in the account of the circulating organs; because it does not require to be so frequently submitted to the action of the air, as in the two classes mentioned above. Hence have resulted the two great differences already pointed out between the lungs of the warm-blooded classes and of reptiles; differences which are obviously related to each other, the numerous vascular ramifications requiring numerous cells and viscera.

The pulmonary serve also as bronchial vessels in reptiles; at least we find no arteries or veins of the latter description. The arterial and venous bloods are mixed in the heart; and the same that goes to the lungs is conveyed to all other parts of the body for their supply.

Yet the pulmonary are not the only arteries conveying blood to the lungs in reptiles: the serpents, at least, offer an exception. The ramifications of the pulmonary artery are confined to that part of the lung, which has a reticulated internal surface. The posterior part of the organ, composing the simple membranous bag, receives blood only from the arteries of the body. A part of the twigs that supply it comes from the branches of the posterior aorta, which are also distributed on the stomach. Other very minute ones are detached successively from the vertebral column. The veins corresponding to these arteries pour their blood into the vena cava. In this singular structure, we find a part of the lung executing the office of the cells of birds; and a portion of the blood, very small indeed, contained in the arteries of the body, is again submitted to the action of the air.

That portion of the general serous membrane which covers the lung has nothing peculiar in reptiles.

The form and bulk of the organs vary much more in this class, than in the mammalia and birds. Both are determined in the mammalia by the cavity of the thorax; in birds, by the peritoneal cells, which limit them on one side, and by the ribs, which cover them on the other. In reptiles, on the contrary, nothing seems to limit their development, nor to give them a peculiar figure. Commonly they form oval bags, which extend in the chelonians along the back to the pelvis, above all the viscera; they are less extensive in the saurians and batracians. The serpents have a single very long lung, prolonged over the œsophagus, stomach, and liver, beyond the latter parts. In this situation it is exposed to pressure every time the animal swallows a large prey. Does this check the pulmonary circulation, and contribute to the torpor which serpents experience at these times?

In the camelion, and the agame marmorata, each pulmonary sac is very extensive. They are divided into large conical appendices, prolonged as far as the pelvis, placed among the viscera, and capable of holding so much air, as to increase the animals' bulk considerably when they are distended. The lungs of the firen lacertina are two long cylindrical sacs, continued to the end of the abdominal cavity. In the larvæ of the salamander, there is a small oval cavity, opening by a narrow canal in the fauces.

Branchiæ or Gills.—The first orders of reptiles (the chelonians, saurians, and ophidians) never possess this kind of respiratory organ: they have only lungs. The batracians in their first state, and the proteus and firen during life, have both lungs and branchiæ, or rather branchial appendages (appendices fimbriati). See the anatomy of the tadpole, and that of the proteus and firen, at the end of this article.

Expansive Power of the Lungs.—"A singular power," says Blumenbach, "characterises these viscera in reptiles, and

is a point, in which they exceed those of the human subject, and of the other mammalia; namely, a particular kind of tone, or energy, by virtue of which, even when the chest is opened, and they are exposed to the external air, they are still distended and support themselves, while those of the mammalia, when the sternum is removed, and the thoracic cavities exposed, allow the air to rush out, and collapse. (See Morgagni Adversarij. Anat. 5, 29, and the elegant experiments on the tortoise by the Parisian academicians; Hist. des Animaux, part ii. p. 194.) It is even asserted, that when the lung is compressed in a tortoise opened alive, it has the power of distending itself again. (Coiter Obs. Anat. Chir. p. 127.) A tortoise, from whom the lower shell had been removed, the thorax consequently being opened, and the lungs exposed to the air, survived for seven days. (Hist. des Animaux, just quoted.) The cause of these phenomena can only be found in the peculiar vital properties of the lungs; as it cannot be referred to contractility, irritability, or nervous influence. I have never been able to detect, in the lungs of amphibia, any more appearance of truly muscular texture, than in those of the mammalia, to which a modern author has too liberally assigned irritability. (Varnier in Hist. de la Soc. de Médecine, 1779.) The design of this peculiar vitality in the lungs of amphibia will appear very obvious, when we consider that it exists in animals who have a very imperfect bony thorax, or none at all, or one in great measure incapable of motion. Such is the case with frogs and toads, who are entirely destitute of ribs; with nearly all the tortoises and turtles (excepting, perhaps, a few of the soft species), in whom the whole coverings of the trunk are immoveable, so that neither the thorax, nor the abdominal muscles, can execute those motions in respiration, which they perform in warm-blooded animals."

Mechanism of Respiration.—In this, as well as in other points, the several orders of reptiles differ from each other. The chelonians, whose ribs are in the form of large osseous plates, consolidated to each other, and motionless, are, in effect, like the batracians, some of which have no ribs at all, while in others these bones are too short, and too little susceptible of motion, to be capable of assisting in the process of respiration. In all these animals, then, we can no longer regard these bones as the principal agents of the respiratory function. They also want the diaphragm, like all other reptiles. Consequently the mechanism of respiration differs in them, in its essential points, from that described in the article LUNGS, which belongs to the whole class of mammalia, where the respiratory organs, inclosed in a peculiar cavity, follow all the motions of that cavity.

In fact, it is now well ascertained, that the batracian reptiles swallow air into their lungs. They close the mouth, and dilate the throat, when the external air, rushing through the nostrils, fills the empty space. The sterno-hyoidei, carrying the os hyoides downwards and backwards, are the great agents in this dilatation of the throat: the coraco-hyoidei assist them. When the former muscles are cut, respiration ceases. The elevation of the os hyoides, principally by the stylo-hyoidei, contracts the cavity of the throat, and drives the air into the lungs. The escape of this air from the throat by the nose is, no doubt, says Cuvier, prevented by a valve; but no such structure has been demonstrated. The action of the abdominal muscles, and perhaps a contractile power of the lungs themselves, expel the air from these viscera in expiration. Townson, who has investigated this subject most attentively (see his *Observationes Physiologicae de Respiratione Amphibiorum*, 8vo. Vienna, 1798, with figures; also translated into English in his "Tracts," observes, that

he does not know whether the muscles extending from the glottis to the pubes should be called oblique or not. They surround the lungs in their whole extent, and have a considerable compressive force. They probably consist of different muscles; their fibres extend more or less transversely, and are therefore well calculated to produce the effect he has assigned to them. He states that he has always seen the frog's lungs collapse when the glottis was opened, whether the animal was dead or alive.

If the muscles and the membrane of the throat are removed, leaving only the sterno-hyoidei, the motions of the os hyoides, which take place in respiration, are continued, although respiration itself is destroyed. The latter effect is a consequence of the destruction of the throat; no cavity can now be formed to receive the air, which the animal swallows in breathing. The os hyoides, however, is alternately depressed and elevated, and the glottis continues to open and shut, but the lungs are permanently collapsed. If all the muscles employed in moving the os hyoides are cut, the glottis, whose muscles are entire, is opened and closed. In the same way, when warm-blooded animals have received a large wound in the chest, they make vain efforts to breathe, and to get rid of the painful sensation of suffocation.

It will appear, from the preceding description, that the frog's mouth must be shut when he breathes: and this is so strictly necessary, that the animal perishes from suffocation, if his mouth be kept open. Herholdt and Rafn asserted this in a communication to the Academy of Sciences at Copenhagen, and the point has been verified by Cuvier and Duméril. See Bulletin de la Société Philomatique, N° 30, an. 7. p. 43.

The same mechanism is employed in the chelonians. Deglutition is the only means they can employ for introducing air into their lungs. Having the mouth closed, they alternately contract and dilate the throat, like the batracians, and by the same powers. The air is expelled from the lungs by two pairs of muscles, analogous to the abdominal muscles. These fill the posterior interval between the sternum and the back shell, in which the posterior extremities are folded when at rest. We perceive, at this part, in the chelonians, those motions of contraction and dilatation, which are observed over the whole abdomen in the mammalia.

The first, or outer pair, correspond to the external oblique muscles: it is attached to the whole anterior edge of the pelvis, to the back and front shell, and is extended in the whole posterior interval of these parts. The internal muscle consists of transverse fibres, attached above to the posterior half of the back shell, near the vertebrae, descending on the outside of the viscera, inclosing them, and terminating below in a middle aponeurosis. The latter passes partly under the bladder, and will serve to evacuate that organ when the muscles contract. They compress immediately only a small portion of the lungs; but they press strongly on the abdominal viscera, and through the latter on the lungs, so as to expel the air. Perhaps, too, the lungs may contract by some powers of their own.

The mechanism of respiration, in the saurians and ophiidians, is very analogous to that of birds, inasmuch as this function is particularly executed by the motions of the ribs and of the abdominal muscles. In most of the saurians, the ribs are perfectly similar to those of birds, consisting of two portions, united by a moveable articulation, and forming an angle, which is opened in inspiration, and closed in expiration. The muscles which put them in motion are analogous to those employed for the same purpose in birds.

The ribs of serpents, forming simple arcs, composed merely

merely of an osseous portion, are inclined backwards, and brought near the vertebral column in expiration, and are extended in inspiration. Elevators of the ribs, similar to those of man, but larger in proportion, produce the latter effect, in which they are assisted by intercostal muscles. The muscles carrying the ribs backwards, and thus producing expiration, lie within the chest. They are fixed to the sides of the vertebral column, and correspond in number with the ribs. They are narrow and flattened, forming a kind of muscular ribbons, passing from the vertebral column, over one rib, to be fixed in the next. Other muscular ribbons are attached to the inside of the ribs, descend to be joined together, and then extend across, ending in a thin aponeurosis, which unites the ribbons of each side. These compose the abdominal muscles, and compress the viscera of the great cavity.

Respiration, which consists in warm-blooded animals of a constant regular succession of alternate inspirations and expirations, hardly admitting even a very short interruption, is performed in reptiles at irregular and long intervals, admitting of very long suspension, and capable, therefore, in a much greater degree than in the former classes, of modification by the will of the animal. Hence Linnæus assigned a "pulmo arbitrarius," or voluntary power over the respiratory function, as a distinguishing attribute of the class. The difference, however, between the reptiles and warm-blooded animals is in the length of time for which they can do without respiration: after a longer or shorter interval, its renewal is equally necessary to both.

All reptiles continue breathing constantly as long as they are awake; and the turtles most frequently of all. It is well known that they cannot remain long under water; but are obliged, at short intervals, to come to the surface for a fresh supply of air. Blumenbach observed water newts, when placed in a deep vessel of water, swim up to the top frequently for the purpose of drawing breath.

"On the whole, however," continues Blumenbach, "reptiles cannot only go much longer without breathing than warm-blooded animals, but they can also continue unhurt in vitiated air for a much more considerable time."

"Tortoises have been known to live more than a month with their jaws tightly tied, and their nostrils closed with sealing-wax, (Mery, in Mem. de l'Acad. des Sciences, avant 1699, v. 2.) On the same point we may mention the puzzling, but sufficiently authenticated instances, of toads found alive in the middle of solid trunks of trees, and even in masses of marble and other stones. (See Luidius in Lithophylac. Britann. p. 112. Le Cat in Allion du Lac, Melanges d'Histoire Naturelle, v. 3. p. 95. Gentleman's Magazine, v. 26. 1756, p. 74. Guettard in Mem. sur differ. part. des Sciences et Arts, v. 4. p. 615. Hist. de l'Acad. des Sciences de Berlin, 1782.) There are numerous citations in Haller, de Corp. Hum. Fabrica et Function. v. 7. p. 151, and Kæstner, in the Preface to the German version of the Stockholm Transactions, v. 3.

"Reptiles can also bear to breathe fixed and phlogisticated air much longer than warm-blooded animals. In my experiments at the celebrated cavern of Pyrmont, I constantly found that pigeons could hardly be restored to life if their immersion in that bath of carbonic acid gas was protracted into the second minute. Frogs, however, recovered after staying in it five, six, seven, and even nine minutes. The event of similar trials, made in the famous grotto del Cane, near Naples, corresponds to these. (See Nollet, in the Mem. de l'Acad. des Sciences de Paris, 1750, p. 72. Murray, in the Swedish Transactions, 1775, v. 36. p. 249.) Della Torre found that a toad lived for half an hour in that grotto,

and that a newt was still alive, after having been immersed in this pernicious atmosphere an hour and a quarter.

"Carminati has already shewn how much sooner confined air proves fatal to warm-blooded animals, than to the amphibia. (De animalium ex mephitis et noxiis halitibus interitu, p. 96.) When I have enclosed two sparrows under one bell-glass, and two frogs under another of the same size, the former have perished in convulsions from the vitiated state of their air, while the atmosphere of the other glass had experienced so little change, that a candle or burning coals were not extinguished by it." Specimen, p. 1.

The experiments of Boyle (Philos. Transf. 1670, N° 62.), and the Florentine academicians, which have been since most frequently repeated, have shewn that serpents, frogs, &c. can remain very long (from two or three to ten or twelve hours) under an exhausted receiver.

The nature of the changes produced in the air by the respiration of reptiles, has been examined by Spallanzani (Rapports de l'air avec les etres organises, publies par Senebier, 3 tom. 8vo. Geneve, 1807); Mr. Ellis (Inquiry into the Changes produced on Atmospheric Air, &c. 1807, and Further Inquiry, &c. 1811,) and others. The latter author presents us with a summary of all that has been ascertained, as well as with experiments of his own; we, therefore, extract them in his own words from the works just quoted.

"To obtain a knowledge of the specific changes which the air suffers by the respiration of the amphibia, the following experiments were instituted. A toad, supported on a small hoop, was inclosed in one hundred and eight cubic inches of atmospheric air contained in a jar inverted over water, and standing in a room varying from 55° to 60° Fahrenheit. He died on the fifth day. The water had risen considerably in the jar, and the residual air was still farther diminished by agitation with lime-water, which it rendered turbid. Fifty parts, after being washed in lime-water, were next shaken in the eudiometer with the liquid sulphuret of potassa, and lost only one part of its bulk. The experiment was repeated by confining another toad, in the same manner, in another jar containing forty cubic inches of atmospheric air, inverted over mercury. Under the hoop which supported the animal, was placed a small cup, containing 1.5 cubic inch of the water of potassa, which floated on the mercury. The whole was then set aside in a room, of the temperature of 64°. By the twelfth hour, the mercury had risen nearly half an inch into the jar, which was thickly moistened with vapour, and the breathing of the animal seemed rather languid: by the twenty-first hour, he breathed very faintly; and, by the twenty-fourth hour, he had ceased to breathe. The jar was allowed to stand some hours, at the end of which time the mercury stood about eight-tenths of an inch high, and one-tenth of an inch of fluid was deposited on its surface. The jar was now raised, and diluted sulphuric acid being poured into the alkaline solution, excited in it a very brisk effervescence. It is inferred, therefore, from these experiments, that the oxygenous portion of the air almost entirely disappears during the respiration of these animals, after which they cease to breathe; and that a large portion of carbonic acid is at the same period produced.

"Proceeding on the supposition, that the loss in the bulk of air, evinced by the ascent of the mercury, in the last of the foregoing experiments, arose from the attraction of the carbonic acid by the alkaline solution, we endeavoured to ascertain the proportion which this loss of bulk bore to that of the whole air originally employed. With this view a frog was procured, and placed in a jar of the capacity of forty cubic inches. Under the hoop which supported

ported him, about half way up the jar, was placed a small cup, containing one cubic inch of the water of potassa; and the jar being then filled with atmospheric air, was inverted into a dish of mercury, and kept steady by a weight pressing upon it. In the room in which the animal was placed, the barometer stood at 29.2 inches, and the thermometer at 61°. At the end of twenty-nine hours, the animal was resting quietly on the hoop, with no appearance of distress, and the mercury in the jar, when that in the dish was brought to a level with it, had risen six-tenths of an inch. In twenty-four hours more, the frog was still alive: his respiration seemed now to labour, and he rose often to the top of the jar, as if desirous of escaping, or of obtaining fresh air: the mercury had now risen to 1.15 of an inch. From this time, the difficulty of breathing continued to increase, and, at the close of the fifty-ninth hour, from the commencement of the experiment, after having lain quiet for a considerable time, he gave a convulsive struggle, and moved no more. The mercury in the dish was now brought to a level with that in the jar, and its height was 1.2 of an inch. The barometer, at this period, was 29.8, and the thermometer 65°.

"In order to examine the residual air, we plunged the dish under water, which rising into the jar, displaced the mercury, and the cup, with its solution, was then withdrawn under water. The residual air suffered no diminution by being shaken with lime-water, nor by contact with phosphorus, but it lost rather more than $\frac{1}{10}$ by agitation with the liquid sulphuret of potassa. The jar originally held forty cubic inches, but the animal, with the hoop, cup, and solution, occupied a share equal to four, so that the actual bulk of air employed was 36 cubic inches. Having placed the jar on its bottom, water, to the quantity of 27 cubic inches, was poured in till it reached the point to which the mercury, during the experiment, had risen; and this, therefore, indicated the volume of residual air: it then required nine cubic inches more of water to fill the jar completely, which, consequently, was the bulk of air that had disappeared. Hence,

therefore, we have $\frac{27 \times 29.8}{29.2} = 27.5547$, but $\frac{4 \times 27.554}{483} = 22819$ and $27.554 - .22819 = 27.32651$, the corrected volume of air at the close of the experiment.

But farther, $36 - 27.32651 = 8.67349$, and $\frac{8.67349}{36} =$

$\frac{1}{4.15}$, so that the diminution of bulk which the air suffered

in this experiment is rather greater than $\frac{1}{4.54}$, the propor-

tion of oxygen gas which the atmosphere contains. In a second experiment, another frog lived in the same volume of air about 60 hours, and the diminution which it suffered, after making the necessary reductions, amounted to $\frac{1}{4.868}$

of the whole. Where the carbonic acid, formed by the respiration of another frog, was suffered to remain, the jar, after the death of the animal, adhered firmly to the saucer in which it was inverted, and, when cautiously elevated, the surrounding mercury rushed in; and occupied only about one-tenth of the space which it filled in the above-mentioned cases: the inferences deducible from these facts, instruct us, that the diminution which atmospheric air suffers by the respiration of these animals, bears a near proportion to the oxygen gas which it contains, when all the carbonic acid is removed: and as a small loss of bulk likewise takes place

when this acid is allowed to remain, we must ascribe a part of the observed diminution to the necessary loss which always accompanies the conversion of oxygen gas into carbonic acid.

"It follows from the preceding series of experiments, that the oxygenous portion of the air is changed by the respiration of amphibious animals in the same manner as by that of the other classes, carbonic acid, in proportion thereto, being, in all cases, produced; and that when the whole, or nearly the whole, of that gas is so changed, the animal no longer survives. But, if the animal die when all the oxygen gas is changed, and all the air that has disappeared when the carbonic acid is removed, the oxygen gas, then the bulk of air that remains, and is unchanged, must consist wholly of nitrogen gas; and as this nitrogen gas, joined with the oxygen gas that has disappeared, makes up the whole bulk of air originally employed, it follows also, that, while the oxygen gas of the air has diminished and suffered change, the nitrogenous portion has continued undiminished and unaltered.

"During all these changes operated on the air contained in water, by the respiratory functions of aquatic animals, the water itself seems to suffer little or no alteration. Mr. Carlisle took separate glasses, each containing one pound of distilled water, which was previously boiled to expel all its air, and then inverting them over mercury, he put into them one gold fish, one frog, two leeches, and one fresh-water muscle. The animals were confined several days in these situations, and exposed to the sun during January, in temperature 43° and 48° Fahrenheit; but no air-bubbles were produced in the vessels, nor was there any sensible diminution of the water. The frog died on the third day, the fish on the fifth, the leeches on the eighth, and the muscle on the thirteenth day. This experiment was made to ascertain the changes produced in water by the respiration of aquatic animals; but the water had not undergone any chemical alteration. See Croonian Lecture in the Philos. Transf. 1805." Inquiry, p. 83—88.

Mr. Ellis adduces some additional evidence in his Further Inquiry. "The experiments already detailed in the former work clearly prove, that frogs and toads which belong to this class, entirely convert, by respiration, the oxygen gas of the air into nearly an equal bulk of carbonic acid, without producing any change in its nitrogenous portion. Dr. Carradori also discovered, that these animals lived much longer when they were immersed in water than had a free communication with the atmosphere, than when the air was excluded. (Phil. Mag. vol. 16. p. 245). According to Spallanzani, frogs die sooner in boiled, than in common water. In their respiration, they consume oxygen, and form carbonic acid. Those which have been recently fed, consume more of this gas than those which have suffered a long abstinence. Under great cold they become lethargic, but their heart still continues to beat, and they still, in a smaller degree, continue to change the air; but the consumption of oxygen increases with the increase of temperature. These animals also change the air by their skin, as well as by their lungs; and act upon it after death, and under putrefaction. (Rapports, &c. tom. i. p. 468.) The ova of frogs were likewise found to require air to carry on their evolution. Small tadpoles, while yet attached to the egg, were confined in vessels half filled with water, while the other half contained air, or oxygen or nitrogen gas. Those in the two former vessels were perfectly developed, and became large enough to swim about; but those confined with nitrogen perished. Rapports, &c. tom. i. p. 466.

"Spallanzani extended his experiments to many other animals

imals of this class, and obtained similar results. Different species of serpents he found to die in hydrogen gas, or when confined under water, but to live in common air, and convert its oxygenous portion into carbonic acid. They became lethargic from cold, and the heart then beat very slowly, or not at all, the respiration was then also suspended, and little or no effect was produced in the air. The skin of these animals acted upon the air, as well as the lungs (Rapports, &c. tom. i. p. 249.); and when the blood was reddened by exposure to the air, its oxygen also disappeared, and carbonic acid was produced. (Rapports, &c. tom. i. p. 239. 263.) Similar results were obtained in experiments on the respiration of vipers, tortoises, lizards, and salamanders. Rapports, &c. tom. i. p. 275. 287. 295. 353.

"The preceding facts sufficiently shew, that various animals in all the foregoing classes, and in every stage and form of their existence, require the presence of oxygen gas to maintain the functions of life; that this gas, by the exercise of these functions, is converted into carbonic acid; and that the degree in which this conversion proceeds, depends much on the healthy condition of the animal, and the vigour of its circulating system. Since, also, in every instance where the experiments have been made with the requisite accuracy, the bulk of carbonic acid produced, nearly or exactly equalled that of the oxygen which disappeared, we may conclude, from analogy, that such is universally the extent to which this change in the air takes place in animal respiration; and since, farther, the nitrogen gas of the air appears to suffer no necessary change in the exercise of this function, we may also conclude, that as far as regards the air, the substitution of an equal bulk of carbonic acid for the oxygen gas that is lost, comprises the only essential change which the atmosphere experiences during the performance of this animal process." P. 269—272.

Vital Temperature.—"Since the respiratory organs," says Blumenbach, "may, with great probability, from the numerous investigations and discoveries of the moderns, be regarded as the principal source of animal temperature, we follow a natural arrangement in passing from the consideration of their structure and functions, to a short view of the differences between the natural heat of reptiles and warm-blooded animals.

"Animals, whose lungs are most compact, receiving the greatest supply of blood, and furnished with all the apparatus necessary for sending the whole circulating mass through the minor circulation, are obliged to keep up the respiratory process uninterruptedly from the time of birth, expelling, instead of the pure aerial fluid which they inspire, a noxious air, which corrupts the surrounding atmosphere if confined, possess a high natural temperature, about the 98th degree of Fahrenheit's scale in man, rather higher in some mammalia, and particularly in birds. In reptiles, on the contrary, possessing lungs of a rare and loose texture, with comparatively slender supply of blood, respiration is irregular, interrupted, and in some measure arbitrary; they very slowly vitiate confined air; and exhibit a temperature exceeding, by a few degrees only, that of the surrounding atmosphere. One or two degrees, I say, according to the results of accurate observation on tortoises (Walbaum Chelonograph. p. 26.): for my own experiments on amphibia have not exhibited results sufficiently constant to allow me to draw any certain inference from them." (Specimen, &c. p. 18.) Braun, indeed, has asserted, in the Nov. Comment. Acad. Petrop. t. 13. p. 427, that frogs possess only the temperature of the surrounding medium; but the facts which

we shall advance presently, completely disprove this assertion.

The power which modern investigations have proved warm-blooded animals, and more particularly the human subject, to possess in so high a degree, of being able to endure exposure to heat much above the natural temperature of the body, without having their own heat increased; and, on the contrary, of bearing, with equal facility, the most intense cold, is not withheld from the amphibia, as is proved by the facts which we have related, in order to shew the tenacity of life in this class. It is not, indeed, clear in these cases, as in the experiments, of which man and different mammalia have been the subjects, that the reptiles, when exposed to a degree of heat greater or less than their own, have maintained their own temperature at an uniform standard; on the contrary, indeed, it seems that in a great cold their heat is abstracted, and they become frozen; and it will also be seen, from facts to be brought forward presently, that their heat is variously changed under different circumstances. Now we know that the temperature of the mammalia is not raised beyond its natural level by exposure in an atmospheric medium of 280° Fahr. (see Tillet in Mém. de l'Acad. des Sciences, 1764); and that its standard is equally undisturbed, when the atmosphere is below the freezing point of mercury. (See HEAT, Animal, and MAN.) We may therefore safely assert that man and the mammalia very far exceed reptiles in the power of resisting either great heat or cold; that is, of maintaining a standard temperature under the action of a surrounding atmosphere, considerably exceeding or falling short of their own temperature. The following summary of facts, concerning the temperature of reptiles, is taken from Mr. Ellis's Inquiry.

"Amphibious animals exhibit a great variety in the structure of the respiratory organs, and, consequently, in the degrees of animal heat. Frogs and land tortoises possess a temperature about five degrees higher than that of the medium they inhabit, according to Dr. Martine. The same may be said of sea tortoises, toads, vipers, and all the serpent kind, all of whom have lungs of the same fabric and the same cold constitution of body. (Essay on Thermometers, p. 142.) Mr. Hunter observed that the frog and toad were about four or five degrees warmer than the atmosphere when it was at 35° or 36°; and that, some hours after death, they gradually fell down to the temperature of the surrounding air. (Treatise on the Blood, p. 298.) The difference of temperature appears to increase in a warmer atmosphere; for Mr. Carlisle kept three frogs for many days in an equable atmosphere of 54°, and their stomachs preserved a temperature of 62°. (Philos. Transact. 1805, pt. 1.) In an atmosphere of 58°, Mr. Hunter found the thermometer, introduced into the stomach of a healthy viper, to stand at 68°; but, after the animal was put into a pan, and the pan into a cold mixture of 10°, where it remained about ten minutes, the heat was reduced to 37°, and, in twenty minutes more, to 31°, nor did it sink lower; its tail now began to freeze, and the animal was very weak. A frog also, whose temperature was 44°, when put into a cold mixture, soon fell down to 31°; and beyond this point it was not possible to lessen the heat without destroying the animal. (Obs. on the Animal Economy, p. 104.) A toad being placed in cold water, just deep enough not to cover his mouth, the whole was put into a cold mixture between 10° and 15°. The water froze around the toad, and, as it were, closed him in, but he did not die, and therefore was not frozen. Why the animals, mentioned in these experiments, died before they were frozen, while those which are

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exposed to the atmosphere, in very cold climates, do not die, is a point which Mr. Hunter does not pretend to determine; not knowing the difference, he says, between the effects of a natural and artificial cold. *Ibid.* p. 89, 90.

"The experiments of Mr. Hunter farther prove that the temperature of most of the foregoing animals not only falls rapidly in a colder medium, but that it rises more quickly in a warmer one than that of those which possess a higher standard temperature. In the stomach of a frog, the thermometer rose from 45° to 49° ; the animal was then placed in an atmosphere made warm by heated water, where it remained for 20 minutes, and upon introducing the thermometer again into the stomach, the mercury rose to 64° . (*Ibid.* p. 90.) A healthy viper was put into an atmosphere of 108° , and, in seven minutes, the heat of the animal, both in the stomach and anus, was found to be 92.5° , beyond which it could not be raised in the above heat. An eel, very weak, whose heat was 44° , which was nearly that of the atmosphere, was put into water heated to 65° , for fifteen minutes; and, upon examination, it was of the same degree of heat with the water. The heat of a tench was, in ten minutes, raised from 41° to 55° , both in the stomach and rectum, by being put into water at 65° .

"He found also, that a living and dead tench, and a living and dead eel, put together into warm water, received heat equally fast; and when they were exposed to cold, both the living and the dead admitted the cold likewise with equal quickness. (*Ibid.* 104, 105.) Hence, therefore, the animal heat, in all the classes of animals hitherto mentioned, whether they inhabit the air or the water, seems to follow nearly that of the medium in which they are placed; and their standard temperature cannot, in consequence, be restricted to any fixed point, but must be considered always in relation to that of their surrounding medium.

"Notwithstanding, however, the low degree of heat which these several classes of animals possess, hardly, in some instances, exceeding that of the medium in which they live, yet this small excess is a proof that they possess, within themselves, a power of producing heat. The loss of heat which insects suffer under cold, the fall of temperature which many of the vermes class undergo from the same cause, the melting of snow by the heat of fishes, and the decline of animal heat which the amphibia, when exposed to great cold, experience, all demonstrate that the surrounding medium, whether it be air or water, is constantly drawing off their heat, which renders necessary as constant a re-production of it." P. 218—221.

The great size and beautiful structure of the lungs of reptiles lead us to conclude that they are very important organs in the economy of these animals, although their uses and relations are not yet all satisfactorily ascertained. It seems tolerably certain, that besides their office as respiratory organs, they render the body lighter for swimming in many instances: in this point of view they may be compared to the swimming bladder of fish. It is by the inflation of its large lungs, that the camelion can distend its body so remarkably.

"The lungs, too," says Blumenbach, "are subservient in many reptiles to the production of sound;—I say in many, because some species, even of our reptiles, are, so far as I know, completely dumb: *viz.* the salamander, *lacerta agilis* (green lizard), and *anguis fragilis* (blind-worm); and others utter sound very rarely, and only when in great danger, as the water newts; resembling, in that respect, the mole and hare, which do not cry out until great violence is offered them.

"It has been reported that some mammalia lose their voice

in particular situations, as dogs in certain parts of America: the same thing has been reported of reptiles, for example frog, which G. F. Müller found to be dumb in many regions of Asiatic Russia. *Sammlung Russischer Geschichte*, vii. p. 123." Blumenbach, *Specimen*, &c. p. 15.

Organs of Voice.—The larynx, varying in different genera, as in the other classes, has these characters in common; *viz.* that it has no epiglottis, and is composed of pieces analogous to those of the upper larynx of birds. This is the only vocal organ; there is never an inferior larynx, as in birds. The voice cannot be modified by lips or velum palati, since they do not exist. The degree of aperture of the mouth, and the motions of the tongue, are alone capable of modifying the action of the larynx.

The cartilaginous skeleton of the crocodile's larynx contains five pieces: a nearly square plate, composing all the under surface of the cavity. Two circular pieces or handles, fixed near together at one end, in the middle of the front edge of the plate, and at the other, in the middle of the side. Their body is a little elevated above the square plate, and leaves on each side, between it and that plate, a membranous hollow. The anterior extremity of each piece forms a lateral and vertical prominence, constituting a kind of pillar under the glottis. To the posterior external angle of this plate, a branch is fixed on each side; these join together above, and form, with the back edge of the plate, a complete ring, which is the beginning of the trachea.

The glottis is merely membranous, extending from the junction of the two last-mentioned branches to the middle of the os hyoides, where the membranes composing it are attached. There are neither ventricles nor chordæ vocales. Two muscles act on this apparatus. One comes from below the great plate, surrounds the larynx, ascending obliquely backwards, and joins the corresponding muscle of the other side behind the glottis, which it has the power of closing. The other comes from below the back edge of the same plate; decussates the former, ascending obliquely forwards, and is fixed to the edge of the glottis, which it opens. The first half of the glottis corresponds then to the broad and flat cavity of the larynx; the second, beginning from the two pillars in front, is merely a long and narrow slit. It is only in striking against the two pillars, that the air can produce a whistling noise, if indeed any such be produced at all.

The glottis of the crocodile of the Orinoco, says Humboldt, is surrounded by a thick fleshy ring with circular fibres, which the animal can contract to such a degree, that the slit or opening of the trachea cannot be distinguished. The glottis rests on a round and flat cartilage, analogous to the thyroid of mammalia. The upper part of the trachea presents a singular structure, which we mention here, because it seems subservient to the production of sound. The first nine cartilages are not complete rings, but are joined together above by a transparent, very fine and tense membrane. (See Humboldt *Recueil d'Observations de Zoologie et d'Anatomie comparée*, t. 1. pag. 11. pl. 4.) Geoffroy observed ten annuli thus united in the Nilotic crocodile; Duvernoy sixteen, in a crocodile dissected at the Academy of Sciences, and the Jesuit Missionaries in Siam a larger number. To this membrane, stretched like the parchment of a drum, and thrown into vibrations by the air, the deep and terrific howlings or bellowsings of these dangerous reptiles are ascribed; the glottis being at the same time closed by its muscular ring. *Annales du Muséum*, t. 2. p. 46.

In the iguana, the pillars are scarcely more prominent within than the rest of the parietes; the glottis is very short,

short, and the inferior plate goes forwards and becomes broader, being turned up to form the rudiment of an epiglottis.

The same simplicity of structure prevails in the tupinambis, the common lizard, the tortoises, and serpents; an inferior plate, and two lateral pieces narrowing a little the edges of the glottis. These animals can only be capable of producing hissing sounds.

The mud tortoise has, at the bottom of its organ, a rounded depression, which is not so well marked in the turtle; but it has not any vocal chords. In a great land tortoise of Madagascar, there is a triangular membranous crista, attached to the lower part of the larynx, and ascending in the glottis, which it divides into two. This is analogous to a structure very common in the upper larynx of birds. The edges of the glottis are flat, sharp on the outside, and touch completely.

In the scink, the edge of the glottis is turned a little inwards to form a tense membrane, directed backwards.

In theameleon there are pillars, nearly as in the crocodile, but they are each furnished with a tense membrane directed backwards, and very fit for vibration. In front of them, on each side, a fleshy protuberance is observed, contracting the glottis, which is very short, and terminating in front by a transverse slit. But the most remarkable circumstance about the larynx of theameleon, is a small membranous sac opening below, between the inferior plate of the larynx, and the first ring of the trachea.

Neither the iguanas nor the dragons possess a similar sac, although we observe in them goitres on the outside: these prominences have no relation to the vocal organs.

The frogs, which are so noisy, have a larynx suitable to this character in the size and prominence of its vocal chords. The inferior plate of the larynx is a slender transverse branch, bearing on each side a large ring, which is the origin of the bronchus; for, in these animals there is no tracheal tube. On the front of the transverse branch, two oval pieces are articulated, convex externally, and concave internally, so as to resemble kettle-drums. On the lower edge of each a membrane is stretched internally, which opposes at right angles the course of the air. The edge of this membrane forms the chorda vocalis, which is consequently more isolated than the cartilages, and freer than in any other animal. Above it is the opening of the ventricle of the glottis, occupying all the concavity of the kettledrum cartilage. The upper edge of this cartilage forms the margin of the glottis properly so called. Vicq. d'Azyr conceived that the ventricles communicate by their bottom with the bronchi, and thus ascribed three openings to the larynx of frogs: but this is a mistake.

Besides this apparatus, which is extremely sonorous, male frogs have two bags, each of which opens by a small hole, not in the larynx, but in the bottom of the mouth, at its sides. They pass under the arch of the lower jaw, to make a prominence under the skin on each side under the ear. These bags are distended when the frogs are croaking. They are covered by a muscular tissue capable of compressing them. The female frogs, and toads of both sexes, and the tree-frogs, are destitute of the bags; but the latter have a simple sac under the throat. In this larynx there is a muscle on each side to separate the oval cartilages; and a transverse one in front, passing between them, and calculated to approximate them. For representations of these laryngeal sacs in the frog, see the German collection of Camper's smaller writings, vol. 1. pt. 1. pag. 144. tab. 3. fig. 1—4. Vicq. d'Azyr has represented the rima glottidis of the tortoise, frog, and serpents, in the *Memoires de l'Acad. des Sciences*.

1779, tab. 13; and Tyton that of the rattlesnake, in the *Philos. Transl.* vol. 13. The chordæ vocales, too, are larger in the male than in the female frog.

Voice of Reptiles.—The tortoises and turtles are said to have the power of producing a more or less strong hissing, when affected by any lively feeling; but we do not know of any very clear and satisfactory testimony on the subject. Pliny's observation about the hissing of turtles when floating asleep on the water, has not been confirmed. The large iguanas utter sharp whistling or hissing sounds as they run about the tops of trees. Several serpents hiss, and the large species very loudly. The noise made by the tail of the rattlesnake is not a vocal sound, but produced by a peculiar organ, which we shall describe.

Daudin asserts, that salamanders produce two kinds of feeble sound out of the water; the first is a low sound, produced in the throat, which they swell for that purpose; the second consists in a slight striking of the two lips together, without any motion of the throat.

According to the traveller Bartram, crocodiles produce most prodigious noises. The sound is terrific, particularly in the spring, when these dangerous animals copulate. The noise resembles distant thunder, shaking the country and making it re-echo far and wide. When they are thus bellying by hundreds and thousands at a time, we might suppose, says Bartram, that some violent shock agitates the globe, and shakes it to its very foundations. He also states, that when they strike their jaws together they make a surprising noise, like that of a heavy plank forcibly beaten against the ground.

Humboldt says that the young crocodiles make a noise like cats; and that they utter very piercing cries, just after escaping from the egg, if attacked by a dog. He never heard any vocal sound produced by the old crocodiles; although he lived among them five years, and the fire often attracted them within a few paces of the tents at night. The Indians asserted that the crocodile makes a noise like that of a cow; that its voice is very terrific, but seldom heard, and sometimes just before an earthquake, the approach of which they are said to discern. *Recueil d'Obs. de Zool. et d'Anat. Comp.* p. 11.

Organs of the Generative Functions.—There is a very close analogy in the structure of these parts between reptiles and birds: in both classes there is a cloaca, that is, a cavity common to the generative organs, the feces, and the urine; in both the male has testicles inclosed in the abdomen, while the female organs consist of ovaries and oviducts. The young being leaves the mother in the form of a small egg, which is generally developed out of the body. The generative process, however, in many instances, exhibits in this class very striking peculiarities.

Male Organs.—*The testicles:* the situation and structure of these glands in the three first orders are very analogous to those which they have in birds. They are constantly found in the abdominal cavity, united to the inferior surface of the kidneys (in the chelonians), in front of the latter viscera on each side of the vertebral column (in the saurians and ophiidians), or immediately under their anterior portion (in the batracians). Their form varies in the different genera; they are separated, in the salamanders, into two spherical bodies, placed one before the other.

The kidney, testis, and epididymis, lie close together in the testudines, according to Blumenbach; but each of the three organs may be distinguished by its peculiar colour and structure on the first view. There is much obscurity in the different descriptions of the male organs in the turtle and tortoise. Schneider has collected the various obser-

vations on this subject in his natural history of the genus testudo.

Their substance exhibits, in the tortoises, large fasciculi, of which the divisions pass in various directions, united by cellular tissue: these fasciculi are fine, cylindrical, and easily separable in the lizards. In the crocodile, according to Geoffroy, the testes are like those of fish, narrow and elongated, and lying above and in front of the kidneys (probably more correctly in front of and below these glands). In the batracians we can distinguish merely an agglomeration of small white grains interspersed with blood-vessels. No corpus Highmori can be discerned.

Yellow appendages, consisting of a fatty substance surrounded by a membrane, and floating in the abdomen, are connected to the front end of the testes in the frogs and toads.

The *epididymis* of the chelonians is a packet made up by the convolutions of a large canal (the vas deferens), which is tortuous in its whole course, and ends in the cloaca at the part corresponding to the basis of the penis and its canal. It forms, in the lizards, a detached body, large and pyramidal, larger than the testicle, adhering to it only by a small thread, and evidently made up entirely of the convolutions of the vas deferens. The latter passes along the outer edge of the kidney to the cloaca, in which it opens.

In the crocodile the semen is conveyed into two vesiculæ of considerable size, contiguous to each other, placed at the back of the common cloaca, and partly included in a cartilaginous sac. They open into the cloaca by six or seven holes on each side, arranged in a circular form round the meatus urinarius. Geoffroy. If these are vesiculæ feminales, it is the only example we know among reptiles of such organs.

The testis is long and slender, and the relative bulk of the epididymis is less in the ophidians; it soon changes into a vas deferens, also very tortuous, opening in this, as in the preceding orders, into the cloaca. In the latter only the canals are inserted in a papilla, which has been incorrectly described as a penis. A more minute account of these organs in the viper, may be seen in Charas, Description Anatomique de la Vipère.

Vesiculæ Seminales.—There is no reservoir analogous to the vesiculæ feminales properly so called, nor to the accessory vesiculæ of some mammalia in any of the other classes of vertebral animals. They have been spoken of in the viper and the batracians, as well as in some birds; but it seems that a simple dilatation of the vas deferens has been mistaken for them. Possibly future researches may shew that the arrangement mentioned above in the crocodile constitutes an exception to this remark. This is the statement of Cuvier. Blumenbach speaks of large vesiculæ feminales in the frog, which are wanting in the toad. § 324. (See Roefel Hist. Ran. Nost. tab. 5, 6, and 21.) Charas, in his description of the viper, speaks of two reservoirs connected with the vasa deferentia, and always full of a fluid, like that of the testicles, under the name of vesiculæ feminales.

The secretion of the testicles, as observed by Spallanzani in the frog and toad, was a transparent fluid like water. From the parts, which he calls vesiculæ feminales, of the frog, he could procure at the time of copulation from two to three grains of this fluid. In the water newt it was, in colour and consistence, like thick milk. He could not discover in it any remarkable sensible property—nothing pungent—nothing acid or alkaline. (Dissertations, v. 2.) He also found the seminal fluid, both of the frog and newt, to abound with the living vermiculi. Tracts, v. 1. p. 300 and 301.

Organs of Copulation.—There are two species of union between the male and female. In the greater number there is a male organ introduced into the body of the female, and conveying the fecundating liquor: but in the batracians, which have no male organ, there is merely a conjunction of their bodies, it is a prehension by the male rather than a true copulation.

In the males of those batracians which copulate thus, there is a peculiar organisation of the skin of the hand. Firm tubercles, composed of hard, blackish or brown papillæ, cover not only the thumb, but also the palm of the hand. These being pressed into the skin of the female, give the male a very firm hold. They disappear after the season of copulation, and are not seen again until that season recurs. The copulation of the frog kind is effected in the following way: the male ascends the back of the female, passes his front limbs under her axillæ, and carries them round the chest, until the fingers cross in front. He continues grasping her firmly in this way until the laying is finished. The posterior part of his body passes beyond that of the female, so that he can fecundate the eggs as they are expelled, and he is said to assist in that operation. They remain joined for several days, and the grasp of the male is so firm, that great force is necessary to separate him. Contusion and laceration of the breast, and even the death of the female, sometimes follow the violent straining of the male. (See Spallanzani's Dissertations, vol. i. p. 17.) The males are more brilliant at the season of copulation, which takes place only once a-year, in the early spring; they inflate their vocal bladder more frequently, and indulge in their croaking noise. In the salamanders a crest, with divided edge, appears on the back and tail, and is afterwards, in great measure, lost.

The duration of copulation in the frogs is inversely proportional to the warmth of the atmosphere. When this is considerable, the female will be free in five or six days; but, in a cold season, the embraces of the male continue for eight or nine days. The season of re-production is the beginning of spring: in the very first days, the frogs begin to stir themselves in our marshes and ponds: they copulate, lay and fecundate their eggs very soon. At the same season, the tortoises, lizards, and serpents, accomplish the same process. Sometimes frogs are found united even before the frosts have ended. Daudin found two frogs in copulation in the middle of February, the thermometer of Reaumur at 3° above zero; it descended in the night to 4° below 0; and the pond was frozen for two days; at the end of which time the female began to lay. Hist. Nat. des Reptiles, vol. i. p. 207, 208.

One of the toads, on which Spallanzani made his experiments, copulates in the beginning of March or end of February, before all the snow is melted; the process lasts ten, twelve, fourteen, or even twenty days, if the season be cold. Spallanzani, ch. 3.

The abdomen swells greatly in both sexes during copulation; in the female, from the enlargement of the ova; in the male, from the deposition under the skin of a very limpid water, which disappears after the laying.

The tree-frogs, at least that of Europe (*hyla viridis*) do not copulate like the frog and toad. The male fixes himself on the female, by merely applying his anterior paws under her axillæ, and employing the tubercles of the fingers. He remains in this situation for twelve or fifteen hours, or even, according to Roefel, three days.

The salamanders do not copulate at all; the male places his head on that of the female, and discharges the seminal fluid, which is received by the female organs. See Spallanzani,

zani, Diff. vol. 2 ; and Latreille, Histoire Naturelle des Salamandres de France.

Penis.—The chelonians have one ; most of the saurians, and the ophidians, have two ; and the batracians none. There is a papilla in the cloaca, in place of the penis, but none in the toad.

The relative size of the organ is more considerable in the chelonians than in the mammalia and birds. It is long, nearly cylindrical, and expanded at the end, which terminates in an obtuse hook-like point, somewhat resembling the end of the elephant's trunk. A deep groove runs along the whole upper surface of the member, and is even deeper near the glans. It terminates on the broad expanded end of the latter, by an orifice divided into two by a papilla. The approximation of its edges converts this groove into a canal : it supplies the place of the urethra. This penis is composed of two corpora cavernosa, confounded together in a part of its extent. They begin by two vascular swellings analogous to the bulb of the urethra : their tissue is continued into two canals, of which the fibrous parietes, at first thin, soon become very thick, while their cavities diminish, and are united near the glans into one. The whole large swelling composing the glans is merely a development of the vascular tissue of the latter, covered by a loose and plaited skin, and supported by a prolongation of the fibrous side of the corpus cavernosum.

The skin of the groove is covered by a cavernous texture, analogous to that of the os rich ; and there is, on each side of this groove, a canal, the orifice of which is in the cavity of the peritoneum, on each side of the bladder, while the canal itself is prolonged in the substance of the penis, as far as the glans, where it ends in a cul-de-sac, without its sides appearing perforated in any part.

This penis has two retractor muscles, arising in the pelvis, and reaching as far as the glans. They fold back the penis in the cloaca, so that, like the penis of the os rich, it shuts the orifice of the rectum, and that of the bladder. Erection, and the action of the sphincter, bring it out of the cavity.

The penises of the lizards and serpents are short, cylindrical, commonly beset with white, hard, and pointed papillæ, which have been tolerably well compared to the prickles of the hedge-hog. These organs, in their collapsed state, are drawn within the skin of the tail : when erect they are protruded, and appear at each angle of the external slit of the cloaca. They have two retractor muscles, arising under the first caudal vertebrae. Tyfon has figured the penis of the rattlesnake and viper in the Philos. Transf. v. 13, tab. 1 ; and the latter is minutely described by Charas.

The penis of the crocodile is single, and lodged in a fold of the anterior part of the cloaca. It is composed of a firm cartilaginous substance, terminated by a glans of softer texture. It is excavated in its whole length by a deep groove. It has a very large retractor muscle, which is so considerable as even to cause a swelling of the tail.

In the saurian reptiles, as in the frog and salamanders, the male fixes himself on the female, and obliges her to turn towards him the posterior part of her body, and a real copulation ensues.

The act is differently accomplished in the serpents : the male and female twine round each other, are closely connected by several turns, and remain thus adherent for one or two hours. Is the small horny spur, situated on each side of the anus in the box, and retractile under the skin, employed at all by the serpent as an organ of prehension, like the cutaneous tubercles of the hand of the ranæ ? The

saurians and serpents conceal themselves carefully for this purpose.

Although the chelonian reptiles seem so little calculated for copulation, this process takes place in them, the male fixing himself to the female by attaching the nails of his front limbs to the soft skin of her neck. Naturalists are still uncertain, whether turtles are joined plastron to plastron, as Lacépède has asserted in his Natural History of Oviparous Quadrupeds, or whether the male mounts on the back of the female, as Bomare has represented it in his Dictionnaire d'Histoire Naturelle. From the word *cavalage*, employed by the French mariners to denote this union, we may infer that they copulate like the frogs : the expression denotes clearly that the male is mounted on the female as the stallion is on the mare (cavale). Catfish, in his Natural History of Carolina, asserts that they remain united for many days.

Female Organs of Generation.—Reptiles have two ovaries, usually much more considerable than the single ovary of birds. For most of the year these bodies are small : but they acquire, at the propagating season, an extraordinary development, and thus distend the abdomen very remarkably. This is particularly observable in the frog kind.

In autumn and winter, says Spallanzani, the immature eggs lie all in the ovarium, which is divided into two lobes : these lobes consist of lesser lobes, each of which is invested with a peculiar membrane. The eggs are of two sizes ; some very small, so as to be scarcely visible with the naked eye ; others seven or eight times larger ; both kinds are globular. The smaller are of a livid grey colour : of the larger one hemisphere is white, the other black. The slightest touch is sufficient to burst them, after which they are resolved into a cineritious viscid liquor. (Dissertations, v. 1. § 4.) The black spots of the surface, supposed by Valisneri and others to be the rudiments of the tadpole, are attached to the internal membrane, and have no connection with the eggs. In the spring the eggs of the largest kind are still larger, and they are mature when copulation takes place. In the first periods of copulation, they are found in the sac of the ovarium ; during the succeeding times, partly in the ovarium and partly in the oviducts, where they become enveloped by their covering of viscid transparent mucilage.

The ovaria of the salamander contain a multitude of little eggs of a yellowish-white colour, smaller than husked millet, and not floating loose in the cavity of the ovaria, but adhering to their sides. These increase in size at the approach of spring.

The ovaria are connected to two long productions of peritoneum, which are fixed on each side of the spine down to the pelvis. The ova are ranged along the loose edge of this fold, either in a single row, as in the chelonians, or agglomerated in a much larger number, as in the batracians. Their blood-vessels extend between the laminae of these membranous productions. In the batracians there are yellow fatty appendages to the ovaries, like those of the testicles.

In the serpents, like all their other viscera, they partake of the elongated figure of the body. The ova, consisting of yellow vesicles, resemble rows of beads.

Oviducts.—There are two in all reptiles, like their ovaries. They are membranous canals, fixed on each side of the vertebral column by a production of peritoneum. They commence by an expanded orifice (imbriated opening of the Fallopian tube in mammalia), at which the ova enter. The tube is first conical, diminishing a little in size ; then it is cylindrical in the rest of its course, which has a much greater proportional

tional length than in birds. In consequence of this length of the canal it is plaited on the production of the peritoneum in the chelonian, laurian, and ophidian orders, or extremely finuous and folded on itself in the batracians. When the curvatures are destroyed, and the duct is stretched in a straight line, it is four times the length of the animal in the salamander. Its parietes consist at first of a thin membrane, they become afterwards thicker, and assume the appearance of a glandular structure. The oviducts end in the frogs by a dilatation, which opens into the cloaca.

The thick fleshy part of the oviduct in the tortoises has been frequently called the uterus: the two oviducts open separately. Caldesi osservaz. intorno alle Tartarughe, tab. 6, fig. 9, 10.

An uterus is also spoken of by some in the frogs, although the generation of these animals has nothing in it like utero-gestation, and the ova are simply transmitted through the tubes, without being retained in them to undergo any part of their development. "The frogs of this country," says Blumenbach, "have a large uterus divided by an internal partition into two cavities, from which two long convoluted oviducts arise, and terminate by open orifices at the sides of the heart. As the ovaria lie under the liver, it is difficult to understand how the ova get into the above-mentioned openings. The uterus opens into the cloaca." (Comparative Anatomy, translated by Lawrence, p. 446.) "The toads have not the large uterus, but their oviducts terminate by a common tube in the cloaca." (Ibid.) For delineations of these parts in the frog and toad, see Roefel, tab. 6, 7, 8, and 21. The rana pipa (Surinam toad) has the same structure. See Camper in the 9th vol. of Commentat. Soc. Reg. Scient. Gotting. p. 129. Also in his Kleinere Schriften, v. 1. pt. 1. tab. 3. fig. 1.

Female Organs of Copulation.—The male penis in copulation passes into the female cloaca. Does it go into the oviducts?

The chelonian reptiles have a clitoris very analogous to the penis of the male, from which it differs only in its smaller size. It is long, grooved lengthwise, and terminated by a rounded glans. Retractor muscles, analogous to those of the penis, draw back the clitoris into the cloaca, when it has been extended.

No clitoris has been discovered in the other reptiles.

Dorsal Cells of the Rana Pipa (Surinam toad, bufo dorfiger).—It is singular enough to meet with in a toad a structure analogous to that of the abdominal pouch of the marsupial mammalia. The skin of the bulk is excavated in the female pipa by a large number of cells, (of which, Cuvier says, eighty have been counted,) in which the ova are placed, and changed into tadpoles, and the latter grow and are metamorphosed. As far as an examination of individuals, preserved for a long time in spirits of wine, will enable us to judge, the parietes of these cells do not seem to have any thing in their organization distinct from the rest of the skin.

Naturalists supposed at first, that the ova grew on the back of the female, and that the male fecundated them in that situation: but observation of the living animal, and anatomical investigations, have shewn the incorrectness of this notion; have proved, that the generative organs resemble those of other female toads; that the pipa lays her ova like the other toads; and that the male fastened on her, as in the ordinary mode belonging to this order, covers her with the eggs after they have been fecundated. The eggs are then enveloped in a fluid, which causes the skin of the back to swell round them: thus they are contained in

rounded cavities. The tadpoles are produced there, with their membranous tails, and are developed in this situation, which they do not quit until they have reached their perfect state. The female then causes the cells to disappear from her back, by rubbing it against hard substances. Besides the works of Camper already referred to, concerning the anatomy of this extraordinary creature, see Blumenbach's Abbildungen, N^o 36, for excellent figures of the animal, and of its young in three states: 1st, as a long-tailed tadpole, with small processes of hind legs, and no trace of fore limbs; 2dly, as a four-footed creature, with the tail reduced to an insignificant size; and 3dly, with the tail entirely removed. The skeleton is figured by Schneider, in his Hist. Amphib. Fascic. 1.

Physiology of the Generative Organs.—In the whole class it is quite obvious, that the germ or rudiment of the new being is produced by the female in the ovarium, a point which does not admit of direct proof in the mammalia. This "pre-existence of the germ" to the act of copulation, and its formation in a peculiar organ of the female, demonstrated so clearly in reptiles, illustrate one of the most curious points in the theory of the natural reproduction of organized beings, or generation, and overturn many of the speculations on that subject. These germs acquire considerable size in the ovaries, and are therefore distinctly visible before the approach of the male. They pass from the parts just mentioned into the oviducts, and thence out of the body through the cloaca, having received in their passage through the ducts some external coverings. An application of the fecundating liquor secreted by the male is necessary to the evolution of these germs; they may be ejected from the body without the embraces of the male, as in the frog, toad, or newt, if they are forcibly separated from the male after copulation has begun, but then they are not evolved.

Swammerdam and Roefel were of opinion, that the eggs were loose in the abdominal cavity, and taken up thence by the oviduct. Spallanzani found them in the abdomen only thrice in more than two thousand dissections; and hence supposes that the circumstance must have been a deviation from the accustomed course in these instances.

Although the motions and vital functions of reptiles seem very languid in comparison to those of the warm-blooded classes, they exhibit considerable ardour and manifestations of lively feeling in their amours. "As soon," says Spallanzani, "as the eggs begin to be discharged, the agitation of the female is extreme; she darts backwards and forwards, rises towards the surface of the water, and then sinks, keeping the hind legs constantly stretched out, and croaking in a low voice. The male, keeping his hind legs close to his body, throws himself into strange contortions, and accompanies the croaking of the female with a kind of interrupted noise, which I cannot express by words." Dissertations, v. 2. § 11.

In the work just quoted, which contains the most original and interesting collection of facts concerning the whole affair of generation, Spallanzani gives the following account of the amours of the water newt, which are the more curious, inasmuch as there is not only no real copulation by the introduction of a male member into the female organs, but not even any conjunction of the bodies, as in frogs and toads. "The male pursues the female, which at first makes a show of flying, but then stops of her own accord. He then approaches her in such a manner, that the lower part of his head comes in contact with the upper part of the head of the female; and this is done while the animals are in such a posture, that their bodies form an angle,

angle, of which the point is made by the union of the two heads; or they may only join muzzle to muzzle. The bodies are always very near together, so that the angle formed by the two heads or muzzles is always very acute. Then the male erects that dentated prominence, which is placed on his back, and agitates it in a curious manner: he also moves his tail briskly, bending it about, and striking very gently the sides of the female. During this time he emits from the aperture of the anus, now unusually tumid and dilated, a copious jet of semen, which mixes with the water, and thus diluted arrives at the anus of the female, also more enlarged than usual. In this important operation, then, the anus of the male is never in contact with that of the female, which maintains a greater or smaller distance, and never shews any part characteristic of her sex. After the male has discharged this jet of semen, he rests for a while, on some occasions quitting the female; he then returns to his employment, and repeats the contortions of his tail, and the emission of semen." § 80.

In the land newts there is a momentary copulation: "in the clearest days, and in the places most exposed to the sun, the male runs after the female, and when he has overtaken her, he twines himself about her, and unites his genitals to her's, but this union may be termed momentary, after which they part." § 81.

The vehemence of the propensity in amphibia is so remarkable, that they actually will copulate with other species, as frogs with toads, &c. No example of hybrid offspring, from such a conjunction, has been recorded. It has also been known, that frogs, in want of a female, have copulated with other males, or with dead females.

That the animals are entirely absorbed by the powerful emotions accompanying this act is evinced by a series of disgusting experiments of Spallanzani, pursued and multiplied with an unrelenting and unnecessary cruelty, and related quite coolly, without evidence of remorse or the slightest apology. He pricked, cut, and hacked the male frog and toads, without making them loose their hold; amputation of the limbs, and of the head, was equally ineffectual.

Males, after suffering amputation of the fore or hind limbs, renewed their situation, and completed the generative act. "Nay, even the decapitation of a frog did not stop the embraces or fecundation. It is well known, that these animals are so tenacious of life, that that operation does not take it away immediately. That of which I am speaking was thrown into convulsions; but neither the fore-feet nor legs quitted the breast of the female, which brought forth her fetuses in an hour and three quarters, and I was an eye-witness to the male's besprinkling them with semen; that they were fecundated there can be no doubt, since they came to life at the usual time. As soon as he had performed this operation, he deserted his situation, and died in four hours afterwards." *Dissertations*, v. 2. § 90 and 100.

All reptiles may be said to be oviparous; an egg, containing the germ, and as much nourishment as is necessary to support it until it is sufficiently developed to leave this abode, is formed in the body of the mother, and enters the oviduct in all. But there is a subdivision, according to the subsequent progress of the egg thus produced. In the greatest number of reptiles, the ova or eggs are laid by the female in that state, and the young reptiles are developed afterwards: but in some, as the venomous serpents, and the true salamander, the ovum may be said to be hatched in the oviduct, although the animals still come into the world so far enveloped by the membranes, that the character of an oviparous generation is

preserved. The reptiles of the latter kind are called ovoviviparous.

In both these cases, a real egg, like that of birds, is produced, and has no connection with the body of the mother; it is a very different thing from the ovum of the mammiferous animals, in which there is no supply of nourishment for the fœtus; and the latter is connected by the umbilical chord with the vessels of the mother, and derives from this source the materials of its growth. Here, as no true egg is produced in any part of the process, and as the young are always brought into the world alive, they may be justly termed viviparous. See Lacépède, *Hist. Naturelle des Serpens*, t. i. p. 31.

In using the common term ovum, we do not mean to represent that the thing produced is the same in all; nor that it is like the egg of birds in all. There are varieties in the different orders, and, in the batracians at least, there is not a very close analogy to the ova of birds.

The eggs of reptiles are covered with a membranous, rather than calcareous shell; but there is some earthy matter in it. In the green turtle this shell is flexible, but contains earthy particles. It is composed of a soft membrane, containing albumen, which heat does not harden, and a yolk which it does. The eggs of lizards have a more or less hard shell: it is flexible in the grey lizard, hard in the scink mabouya, and the crocodile. It has been asserted, that the eggs of the iguana are not hardened by boiling. The covering of the egg is soft and calcareous in serpents. The batracians lay gelatinous and semitransparent eggs, without any covering.

A part, corresponding more or less closely to the yolk of a bird's egg, is produced in the ovary, escapes from its membranous covering, and enters the oviduct, where it receives its external investment, as the yolk of the bird's egg receives its shell and albumen. In the turtle, the process seems very similar to what we see in birds. There are numerous large yolks observed in the ovarium, contained in calyces; and these, when boiled, are very similar to the yolks of birds. In the crocodile and serpents, it is nearly the same. But in frogs, toads, and newts, the egg in the ovary does not seem to be a yolk, but the rudiment of the tadpole; and it comes forth, surrounded by a quantity of transparent glutinous matter. In the toad and newt, these rudiments are formed into long cords by the glutinous medium, which cords are double in the toad. In the frog they come out separately in so many spheres of the gelatinous matter, about the size of large peas.

In all the reptiles which have a penis, fecundation is effected within the body; but in the batracians, which have no male organ of copulation, it occurs externally. When frogs are joined, it may be seen, that an obtuse, tumid point, occupying the place of the penis, is elongated, and brought towards the eggs nearest the vent. By taking them out of water while this laying is going on, an actual discharge of seminal fluid upon the eggs may be seen from this point. In the same way the male of the water newt discharges his fluid into the water near the anus of the female, and thus fecundation takes place. Spallanzani has instituted an immense number of experiments on this subject; they prove, that if breeches be put on the frog, so as to receive the seminal fluid, no fecundation occurs; while, on the contrary, the seminal fluid from the epididymis, or the juice of the testicles, will produce artificial fecundation of eggs laid by the female after the male has been removed, and otherwise unproductive, or of eggs taken out of the lower part of the oviduct immediately after death. Dilution of the seminal fluid, although it diminished the effect of its application, did

did not altogether prevent it. When three grains of seed were added to twenty-two pounds of water, some tadpoles were evolved in it, but much fewer than in a stronger mixture.

As fecundation is effected in these animals by the feminal fluid discharged in water, it probably is always produced by an extremely small proportion. Spallanzani has made some calculations, in order to find out the expression in numbers of the quantity of semen that was efficacious in some of his experiments. He mixed three grains of feminal fluid with eighteen ounces of water, and found that a globule, $\frac{1}{4}$ th of a line in diameter, taken out of this mixture, was often sufficient to fecundate a tadpole. The ratio of the tadpole to the particles of seed diffused in this drop of water, is found to be as 106,477,777,7 to one. The weight

of the seed is $\frac{1}{199,468,750,0}$ of a grain, and its bulk

$\frac{1}{300,212,042,0}$ of a cubic line. Dissertations, v. i. § 655.

He found, however, that although so minute a quantity of feminal fluid is sufficient to produce the effect, there must be contact of the gross and visible part of the fluid; that no vapour or effluvia, no *aura spermatica* will suffice. Diss. ch. 5. § 161—170.

The seed of one species will not fecundate another; that of the water newt has no effect on the embryos of frogs and toads; nor reciprocally: neither is there any action of the seeds of frogs on toads, nor *vice versa*. § 171—172.

The number of eggs is subject to much variety: it is inconsiderable in the serpents; from ten to twenty in the vipers and lizards; one or two hundred in the crocodile, according to Bartram, Travels in America; two or three hundred in the turtle; but the most numerous in the frog kind. In the toad, where the eggs are laid in a double row, forming a cord of a glutinous nature, these rows measured 43 Paris feet, and contained 1207 eggs. Spallanzani Diss. v. ii. § 45.

In the testudines, serpents, and lizards, which have a true yolk, this is to be regarded as a supply of nourishment for the young animal, whose evolution probably goes on in a manner analogous to what is observed in birds; although the process has not been actually watched, nor the order and succession of the changes observed, as in that class. Blumenbach has delineated the egg of the crocodile, with the young one coming forth; the shell is flexible, as in the other amphibia, and consists of a thick, leathery, and tough, external stratum, marked throughout with extremely fine undulated lines, and lined by a more delicate smooth membrane. The recent eggs, and the young crocodiles which they contain after evolution has commenced, are eaten by various African tribes. The relation in size between the egg (about equal to that of the goose), and the full grown animal (the Nilotic species), which reaches to thirty feet in length, or even more, is at first view remarkable; and Herodotus has called the crocodile the largest animal from the smallest egg. (Blumenbach's Abbildungen, N° 27.) Seba has also figured a young crocodile, with the membrane of the yolk adhering to the abdomen, as in birds. Thefaurus, t. i. pl. 104, fig. 7.

In the animals just enumerated, the eggs, whether deposited in the sand of the sea-shore, or of the banks of rivers, in the holes of trees, the chinks of walls and rocks, &c. undergo no process of incubation like those of birds, but are developed in the ordinary temperature of the atmosphere, and the young animals come forth from their confinement, differing only in size and proportions from their parents.

In the venomous serpents, and the salamanders, the case is different. The egg containing, as in the preceding instances, the young animal, and a sufficient supply of nutriment for its growth, until it is of size to quit its original abode, is hatched in the oviduct of the mother, and the young come forth from the cloaca alive, but surrounded by their membranous coverings. The young vipers and other venomous serpents, when they are born, are freed by the mother from this kind of after-birth.

A very curious circumstance has been observed in some of these, recalling to our minds the abdominal pouches of the marsupial mammalia, and the mode in which they serve as a shelter for the young, while yet too small to suit for themselves. Palisot Beauvois thus relates the fact we allude to. "Having perceived a rattlesnake at some distance, I approached as gently as possible, when, on lifting my hand to strike him, he founded his rattle, opened his mouth, and received into it five small serpents, about the size of a quill. I retreated and concealed myself, when the animal, thinking the danger at an end, opened his mouth, and let out his progeny. When I appeared again, they immediately took to their same retreat." He had heard this fact from American planters, and it has been since confirmed by other travellers. Daudin, Hist. Nat. des Reptiles, v. 5. p. 68.

The young of the salamander, like those of the viper, are born alive. The female brings forth very delicate oval vesicles, which may be compared to hydatids, each of which contains a perfect young salamander, an inch in length, moving its tail, and lacerating its coverings at the time of birth, and emerging in the form of a four-footed tadpole.

"In this same strange animal," says Blumenbach, "I have observed a curious fact, already noticed by Wurffain in his Salamandrologia, p. 83. viz. that a female, kept by herself, and absolutely without intercourse with any other of her kind, has produced young ones. I have kept in a glass at home, for five months, a female salamander, whose tail I had cut off, and in the mean time have had no other in the house, nor even seen one. Yet this solitary female, which, to my surprise, sustained so long a fast without growing thin, has begun within a few days to bring forth young, of which thirty-four are now before me, not only living, but very lively. This observation will lead us to two conclusions; 1st, that salamanders really copulate, and that the male does not fecundate the ova as they are discharged, like what we have described in the case of the water newts: 2dly, that salamanders have the same nature in this respect as hens; which, when they have been once impregnated by the cock, will lay fruitful eggs, not for a whole year, as Fabricius ab Aquapendente asserted, but, according to the most accurate researches of Reaumur (art de faire eclorre les oiseaux domestiques, t. 2, § 327), for five weeks after separation from the male.

These young salamanders have a two-edged tail, broadly pinnated on each edge, excellently adapted for swimming, and furnished on each side of the neck with fimbriated branchial appendages like those of the tadpole, which however soon disappear, the two-edged tail being at the same time converted into a cylindrical pointed one." Specimen, &c. 34.

All the reptiles of the frog and toad kind, and the aquatic salamanders, have this remarkable peculiarity, to which nothing at all analogous has been observed in the economy of the warm-blooded classes or the fishes: viz. that they undergo a metamorphosis; and have, in their two states, not only an altogether different external form, but also important differences in many of the great internal organs. In their first state, they are little aquatic animals with tails

and

and large heads; from their twisting movements of the former, and the great size of the latter, they have been called in Latin *gyrini*, in French *têtards*: the English name is tadpoles, and the German *kaulquappen*.

Development of the Frog.—As the spawn of frogs is deposited in ponds, ditches, or other stagnant water, the contained ova are evolved in the ordinary temperature of the atmosphere. In one species of toad, Spallanzani says, that it proceeds at 6° above freezing of Reaumur. He found that a temperature of 111° Fahrenheit, did not interfere with the subsequent evolution; that the number of tadpoles produced was much diminished after exposure to 122°; and that very few were evolved after the eggs had been immersed in water of 132°. A heat of 111° was fatal to tadpoles and frogs; although the latter bear 111° in the warm springs of Pisa. (Tracts, vol. i. p. 32.) Each egg lies in the centre of a transparent spherical mass of mucus; many of which, aggregated together, form what is called frog's spawn. Round the eggs are two concentric membranes, of which the innermost, when pierced with a needle, discharges a fluid as limpid as water. The egg is round, and has a smooth surface, of which one hemisphere is black, and the other white. When the hot season is far advanced, the observer soon perceives the lineaments of the tadpole. The egg grows for some hours without losing its round shape: it is next elongated; the white hemisphere becomes darker, and the black changes into a longitudinal furrow, terminated by two perpendicular processes. And, as it increases in bulk as well as length, the internal circular membrane is dilated, and contains more fluid. By tracing thus the progress of the evolution, we come to perceive that these bodies are not eggs, as naturalists suppose, but real tadpoles. The furrow and the processes become longer; the supposed egg assumes a pointed figure, the whitish hemisphere dilates, and the black is incurvated. The pointed part appears to be the tail of the tadpole, and the other the body. Further, the opposite end takes on the appearance of the head, in the fore part of which the form of the eyes is visible, though they are yet closed. The two processes also, by which the animal fastens itself to bodies, when it is tired of swimming, become evident, as likewise the vestige of the aperture of the mouth, and the rudiments of the gills. As the organs are further unfolded, the tadpole, which has not moved hitherto, begins to stir, and loosen its fetters; at this time it appears clearly, that the internal circular membrane is the amnios, in the liquor of which the tadpole floats; the umbilical chord at last is seen, and becomes still more visible the first day after the animal has quitted his confinement. The cord is not, as in other animals, attached to the belly, but to the region of the head. (Spallanzani's Dissertations, v. 2. § 14—16.) We take the liberty to note what is here said about the umbilical cord as a subject for further research.

The branchiæ are visible towards the end of the sixth day: in the course of the seventh and eighth all the tadpoles quit the viscid substance, which had been floating on the water, and which had hitherto served them for food. By the fourteenth and fifteenth days they are so much grown, that two small but prominent eyes, an open mouth, nostrils, &c. can be distinguished. About the nineteenth and twentieth days the branchial appendages are withdrawn within the skin, and no longer visible. The heart can be seen to move, and the caudal vertebrae are recognisable. On the twenty-fourth day the front limbs, which had already existed under the integuments, appear in the place of the branchiæ, or rather near where they had been. In ten or twelve days more the hind limbs come out. In this state they swim

about in the water, and grow. The tail gradually disappears, and in about two months after they have been hatched, they are metamorphosed into frogs. These at first are small, and then become gradually larger. Except in the case of the *rana paradoxa*, and the *bufo fuscus*, in which the tadpoles become so large, that the animal, when it has changed, is of the adult size.

Anatomy of the Tadpole.—The points in which the animal differs from the organic arrangements of its perfect state, are the large tail, which bears a very considerable proportion to the body, and is afterwards entirely lost; comparative fineness of the mouth, to the under lip of which a small organ is attached for fixing the tadpole to other objects; a kind of horny plate for jaws; two tubercles under the neck, which the animal can distend at pleasure; the rudiments of the lungs; the intestines convoluted in a spiral mass, which swells the abdomen, and far exceeds, in its ratio to the length of the body, the intestinal canal of the perfect animal; the branchial appendages, and the vessels connected with them; the fore limbs, situated at first under the skin. For the series of changes, and the anatomy of the young animal, see the plates of Roefel, Hist. Ranar. Nostrat.

Further particulars of the anatomy of tadpoles, and particularly of the circulating and respiratory organs. In his "Recherches sur les Reptiles douteux," Cuvier has entered at some length into a consideration of the anatomy of the tadpole. The following account, which is translated from his memoir, as published in the "Recueil d'Observations de Zoologie et d'Anatomie comparée, faites dans le Voyage de Humboldt et Bonpand," v. 1. p. 195, is to be understood as applying to the full grown tadpole.

The tadpoles of frogs, tree-frogs, and toads, differ from those of salamanders, principally in having their branchiæ concealed: we have already observed, that in their earlier stages the branchiæ of the former are also external: the only way by which the water can escape from them is through two holes, formed in different situations, according to the species: there are even several which have only one hole, on the left side. Such are the tadpoles of the jackie (*rana paradoxa*), and of the brown toad (*bufo fuscus*); but the tadpole of the common frog has two, both placed below.

We find, on opening the skin of a tadpole longitudinally, that the internal organs are divided into two parts, or contained in two membranous sacs.

The first extends from the horny and false jaws, which form the mouth of the tadpole, to behind the branchiæ, enveloping the latter entirely. The other contains the abdominal viscera; it is the peritoneum, on which vestiges of the abdominal muscles are already visible.

The first sac is very thin and transparent, and penetrated, like the skin, by holes for the exit of the water from the branchiæ.

The latter form on each side four transverse rows of small tufts or fringes, supported by the same number of small cartilaginous arches, which are marked on the side next to the mouth by small rounded tubercles. These cartilaginous arcs are articulated on one side behind the cranium, on the other to a species of os hyoides, and have the same motions as in fishes. In their intervals the water can pass freely from the mouth to the branchiæ, to be discharged subsequently through the small external apertures.

The organization of the branchiæ in the tadpoles of frogs is, therefore, the same as in certain fishes, for example the callionymi and others, where the water can only pass out by narrow apertures: there is, however, this difference,

that they are not covered, either by a branchial operculum, or by radiated bones.

The branchiæ, or gills, properly so called, that is, the immediate organ in which the pulmonary vessels are distributed, are small tufts formed like feathers, that is to say, fringed on the two sides. Each cartilaginous arc supports about thirty such; and in the middle of each tuft are its two principal vessels derived from the two great blood-vessels of the arc.

It may be observed here, that the fishes called syngnathi have also their branchiæ in the form of tufts.

The heart, placed in front of this apparatus, and receiving the blood from the body by the vena cava, which comes, as in most cases, in great part through the liver, has only one auricle and ventricle, as in fishes, and in adult frogs and salamanders, without any of those divisions which are observed in the chelonian and saurian orders. The ventricle gives origin to a single artery, which is completely distributed on the eight branchiæ, so that no drop of blood can go to the rest of the body, without having passed through the respiratory organs. All the blood which has circulated through the gills, is collected in the branchial veins, which go towards the back, and are united into a single trunk, which becomes the descending artery: but, before uniting, they furnish arteries to the head, fore feet, lung, and liver; so that in the tadpole, the lung receives blood which has been already exposed to the action of water; and this small portion of the animal's blood undergoes respiration twice, while, with respect to the great mass of the fluid, there is only one respiration, and that of an aquatic nature, or similar to the respiration of fishes.

Great changes take place when the tadpole becomes a frog; but they are produced by very simple means. As the arms and head increase in size, their arteries are enlarged; the branchiæ, on the contrary, are obliterated, and their arteries are gradually reduced: but, as it is always necessary that blood should go to the head and other parts, one of the four principal branchial arteries on each side is enlarged, and serves to convey it. Then the artery, which goes out of the heart, and was formerly divided into eight branches, is now simply bifurcated, and its two branches supply the arterial trunks of the head, arms, lungs, &c.; and lastly, are united to form the descending aorta. Now this is precisely the circulation of the frog, in order to produce which it has been merely necessary to obliterate six of the branchial arteries of the tadpole, and to enlarge the two others. Henceforward the lungs are the exclusive seat of respiration, receiving, however, at each pulsation, only a small portion of the whole mass: the frog, therefore, is now an aerial animal in respect to its breathing.

While these changes are going on in the respiratory organs, several others are taking place in different parts of the body. The narrow horny bill, preceded by small fleshy lips, falls off, and its muscles disappear; the jaws grow hard, and form a much more ample mouth.

The eyes, disengaged from that skin, which only allowed them to appear through a transparent disk, are now seen with their complicated apparatus of three eye-lids.

The fore-feet, which had been concealed between the bag enclosing the branchiæ and the peritoneum, appear externally; the hind-legs grow every day larger; and the long tail, formed by so many muscular strata, and supplied by such numerous vessels and nerves, begins to disappear. The intestines, formerly of nearly uniform size throughout, excessively long and arranged in a spiral mass, become short, and are dilated at proper parts to form a stomach and colon.

Among these changes, which convert the tadpole into a frog, we cannot enumerate the appearance of the generative organs. The tadpole already possesses testicles, ovaries, and their fatty appendages; and if these parts are not so large as in the frog at the season of reproduction, they approach nearly to their size at other times of the year.

What we have just said concerning the tadpole of the frog is equally applicable to that of the toad; but the different species exhibit considerable varieties in the epocha and the size at which the change occurs, as well as in the rapidity of the change. The jackie (*rana paradoxa*) loses its tail very late, and long after its branchiæ; while the latter do not entirely disappear until it has reached the full size of its perfect state: the pipa, on the contrary, loses both very early, and while it is still very small. The species which lose their branchiæ late, are larger in the tadpole than in the perfect state, because these supernummary organs swell out the front of the body, while the tail prolongs it behind. They seem, therefore, to become smaller under their metamorphosis, and grow no more when they have become frogs. On the other hand, those which lose their tail and branchiæ early, have still a long time to grow, and may be seen of all sizes in the perfect state. This has given rise to the mistaken notion that the jackie is changed into a fish; the tadpoles being larger than the adult frogs, it was not thought possible that the latter could be the second state.

We might restore to the larvæ of the salamanders the name of cordyli, which they bore among the Greeks, according to the remark of Schneider. They ought not at least to have that of tadpole (*têtard*), because they have not a large head, their branchiæ not being concealed under considerable coverings, but floating loosely on the exterior of the body. They are tufts arranged like the teeth of combs, simply fleshy or membranous, and attached by pedicles, which allow them to float loosely in the water. The cartilaginous arcs of the sides merely serve to limit the small apertures through which the water passes out of the mouth; for, although the form and arrangement of the tufts seem to expose them sufficiently to the action of water, there are still openings from the mouth, enabling the animal to establish a current of the fluid. In other respects, the circulation is carried on as in the branchiæ of the tadpoles of frogs, and it undergoes the same changes when the branchiæ are obliterated.

The larvæ of salamanders, observed by Cuvier, had the same viscera as the adult animals, and possessed no horny bill, although their branchiæ were still very complete. He therefore concludes, that in this respect, as well as in their feet, and in the organization and permanence of their tail, there is a much more close resemblance between these larvæ and the adult salamanders, than between tadpoles and frogs.

These remarks on the anatomy of the tadpole, and of the larvæ of salamanders, are illustrated by four figures in the 13th plate of the work quoted above. Figs. 1, 2, and 3 represent the anatomy of the tadpole of the *bufo fuscus*; and fig. 4. that of the larva of the *salamandra aquatica*.

The co-existence in the same animal of branchiæ and lungs, that is, of organs calculated for breathing air, and of those which are fitted to extract air from the water, is not peculiar to the larvæ of frogs and salamanders; it is observed also in the *fioren lacertina* and the *proteus anguinus*, two animals whose construction is in many respects so singular, that the opinions of naturalists concerning them have been long extremely unsettled. Many have supposed them to be the larvæ of some large reptiles, for which opinion, other

other circumstances in their organization and habits, besides the possession of branchiæ and lungs, have been adduced as arguments. Others have contended that they are perfect animals; and the more exact researches of modern naturalists and anatomists seem to have finally proved that this is the case. The anatomical details, by which this conclusion is supported, will be found towards the end of the article.

As the firen and proteus, truly perfect animals, have been sometimes considered as larvæ or imperfect states of unknown reptiles, so the contrary error has been committed, of describing the larvæ of known species as perfect animals allied to the firen and proteus. Laurenti, one of the first naturalists who endeavoured to reduce the class of reptiles to regular order, established a genus (*proteus*) for such batracian reptiles as, according to him, possessed both branchiæ and lungs. To this genus he has assigned the tadpole of the rana paradoxa, under the name of *proteus raninus*; and another, which he himself inspected, and which has since been ascertained to be the larva of an aquatic salamander, under that of *proteus tritonius*. (See his *Specimen medicum exhibens synopsis reptilium*.) The firen operculata of M. de Beauvois (*Transactions of the Philosophical Society of Philadelphia*, vol. iv.) is considered by Cuvier as a similar instance, and perhaps as the very axolotl or Mexican animal, which will be described presently. He regards, in the same light, an animal described by the very learned writer on amphibibia, Mr. Schneider, as found in the lake Champlain: see *Hist. Amphib. Nat. et Litt.* Fascic. 1. p. 50. He says it may be objected that we cannot easily conceive that so complicated an apparatus as that of the branchiæ, their cartilaginous arches, and the muscles moving them, should disappear and leave no trace behind; but, as the larvæ of our salamanders experience such a change, the singularity of the phenomenon cannot be pleaded as an objection to it. *Recherches, &c.* p. 117.

Anatomy of the Axolotl, or large Mexican Salamandrine Tadpole.—Another animal of this kind is one found very commonly in the lake surrounding the city of Mexico, and noticed by the early writers in their accounts of those countries, and of the interesting objects they produce, although not methodically described or scientifically investigated until very lately. Hernandez speaks of it in two places; in one, under the name of the eatable tadpole (*gyrinus edulis*), or *atolocatl* (*Hist. Anim. Miner. Nov. Hisp. lib. unic. Tract. 5. cap. 4. p. 77*: this book is placed at the end of the abridgement by Recchi); in the other, under that of *lufus aquarum*, *piscis ludicrus*, or *axolotl* (*ibid.* cap. 2. p. 76, and in the large abridgement by Recchi of the whole work of Hernandez, lib. 60. cap. 4. p. 316.) This account, accompanied by a figure of some other animal, was copied into other works with various errors.

Dr. Shaw described an individual sent immediately from Mexico to the British Museum, and gave two good figures of it; in the *Naturalist's Miscellany*, N° 343, under the name of *gyrinus mexicanus*; and in the *General Zoology*, vol. 3. pt. 2. pag. 612. pl. 140, under that of firen *pisciformis*, considering it as allied to the genus firen.

Mr. de Humboldt met with it in Mexico, and recognised it as the axolotl of the Mexicans and first Spaniards, under which name it is still known. He brought specimens of it to Europe, and entrusted their anatomical investigation to the experienced hand and profound judgment of Cuvier, whose description we extract from the *Recherches sur les Reptiles douteux*, already quoted, pag. 109. et seq. pl. 12.

Anatomy of the Axolotl.—In its size and general configuration it very closely resembles the salamander terrestris (*lacerta salamandra*) of Europe. No one would hesitate

in calling it a salamander, were it not for the branchiæ, which latter resemble very narrowly those of the larvæ of salamanders, and float loosely at the sides of the neck.

The openings communicating with the mouth are four in number, and much larger than in the firen. A fold of the skin of the head forms a species of operculum for the four. There are four arches, as in fishes, and we should hence expect five openings, but the fourth is immediately united to the trunk. The two intermediate arches have, towards the mouth, two rows of pointed denticuli; but the first and fourth possess, each, only a single row. None of these denticuli exist towards the operculum, so that the first of the four openings is not denticulated in any direction. Each of the four arches has, towards the outside, a sharp membranous crista, which might deceive superficial observation by causing a resemblance to the gills of a fish; but there is no vascular net-work for respiration, and the arterial trunks follow, without any division, the three first arches to arrive at the branchial tufts, which are the only true gills. There are three of these tufts on each side, attached to the three first arches, where the skin joins them together; the operculum and the fourth arch have none. These tufts are much more ramified than those of the firen, but their ramifications resemble a lock of hair, and are not arranged with so much regularity.

Osteology.—The head is the same as in the salamanders, except that the cranium is rather broader. The teeth are placed in the same way on the edges of the jaws; there are moreover two plates immediately behind the edge of the upper jaw; but the two longitudinal series, which are observed along the palate of the European salamanders, could not be perceived. The head is articulated in the atlas by two condyles, as in the firen and salamanders.

The apparatus for supporting the branchiæ is very similar to that of the firen; and, at the time of the metamorphosis, a part of it probably remains to form the os hyoides of the salamander. The middle piece is cylindrical, short, and terminated behind by a forked extremity. The front end supports two cartilages, the ends of which, suspended to the angles of the jaw, correspond to the hyoideal branches of fish: they are immediately under the membranous operculum. From the posterior end of this middle piece proceed two other branches on each side; a broad one supporting the first cartilaginous arch, and a more slender one trifurcated to support the three other arches. The four branchial arches are suspended, by their outer extremities, to the first vertebra.

There are seventeen vertebræ from the head to the pelvis; and twenty-three from the latter to the end of the tail. The spinous processes of both are longer than those of the salamander; and they exist on both aspects of the caudal vertebræ, which makes the vertical measurement of this part exceed that of the European aquatic salamanders.

There are thirteen small ribs on each side, similar to those of the salamander.

The osteology of the limbs resembles in all respects that of the salamander, excepting the more pointed form of the last phalanges, which has occasioned them to be taken for nails.

Organs of Sense.—The eye is smaller in proportion than in European salamanders; but not smaller than that of the species brought from the Alleghany mountains by Michaux.

Organs of Circulation.—The vena cava receives the termination of the veins of the head; of the branchiæ, and their arches; of the lungs; of the fore-feet; lastly, of the inferior vena cava, which has traversed the liver, and received, as

usual, the blood of the vena portarum. It enters a large and single auricle; there is also a single ventricle, giving origin to a large muscular artery, similar in all points to that of fishes, of the furen, and of tadpoles. It produces for the branchiae three arteries on each side, which proceed, as we have already mentioned, along the three first arches. The branchial veins are quickly united behind into a single trunk, under the back of the head, and this vessel, following the direction of the spine, becomes the great artery of the body. This is exactly the circulation of the batracian larvæ; and the axolotl, being larger than any of the European species, affords a convenient opportunity of examining this kind of arrangement in the circulating organ.

Organs of Respiration.—The branchiae of the axolotl, exhibiting on a larger scale the same motions as those of the salamandrine larvæ, the mechanism can be better understood; and the following description of the muscles will, therefore, be received with interest.

Each of the cartilages analogous to the hyoideal branches has a very strong muscle, descending from the basis of the skull along their convex sides to their inferior extremities. These muscles open the branchial arches, by separating their inferior extremities from the palate.

The arches are approximated by a muscle fixed behind to the inferior extremity of the last, advancing under that of the three others, and giving a slip to each. Its antagonist is a small muscle, fixed, on one side, to the inferior extremity of the hyoideal branches; and proceeding backwards as far as under the first branchial arch, to which it is attached, opposite to the slip of the preceding.

The os hyoides is carried forwards by two genio-hyoidei, and backwards by two pubio-hyoidei: which latter supply the place, as in the salamanders, both of the sterno-hyoidei and recti abdominis. It is elevated by a muscle similar to the mylo-hyoideus of the same animals.

Lastly, the three tufts are themselves elevated and depressed by as many pairs of muscles, which are attached above and below to the convexities of the branchial arches, and have their other fixed points in the bases of the tufts.

The lungs are two large bags, on the internal surface of which the blood-vessels form a loose but very conspicuous net-work. There are no cells. They open into a common, membranous, opaque, and tolerably wide canal, supplying the place of trachea, but unfurnished with cartilaginous rings, and contracted to form a small larynx with two membranous lips. The glottis is small, formed by two membranous projections, behind each of which is a small hollow or ventricle, which may be supposed to produce a more powerful voice than that of the furen.

Organs of Digestion.—The tongue possesses but little power of motion; it is free in front, but fixed behind to the anterior extremity of the os hyoides.

The oesophagus is short, folded longitudinally, and continuous with the stomach, which is large and membranous, but considerably narrowed, and more muscular towards the pylorus. It was filled, in the two individuals from which this description was drawn up, with fresh-water cray-fish, like the European, which had been swallowed without mastication, so that entire limbs were found even in the rectum.

The intestinal canal is tolerably large, particularly behind, and of moderate length. It makes two principal folds, and has neither cæcum nor any internal valve. The liver is rectangular, without any deep notches; no gall-bladder was observed. There is a small spleen in the centre of the mesentery, which is simple, as usual.

All these intestines are like those of the salamander.

Generative Organs.—The ovaries, small, flaccid, and hardly

containing visible ova, resemble, in their situation and fatty appendices, those of the salamander. The oviducts were so delicate, that they could scarcely be seen.

From all the circumstances just detailed, and from the close resemblance of all its organs to those of salamanders, and their larvæ, we may conclude, that the Mexican axolotl, or furen pisciformis of Shaw, is the larva of some large salamander.

Growth.—The age of puberty seems to be the limit of growth in many of this class, as in birds, and we may almost say, in all mammalia. But others, particularly the crocodiles, turtles, and serpents, grow constantly; of which continual increase the whales seem to afford an example among mammalia; at least, no limits can at present be assigned to their stature. We know little about the length of life of the amphibia. Many, particularly the tortoises, serpents, and crocodiles, are prodigiously long-lived; coming forth originally from an egg, which is very small in comparison to their future stature, growing very slowly, and reaching an immense size. Niebuhr saw at Surat a tortoise 125 years old.

Organs of the Animal Functions.

Organs of Motion. Description of the Bones.—We know of nothing peculiar in the organisation of the bony substance of reptiles. In the larger species, the bones possess as much firmness as in the mammalia; but in the smaller, as the frogs for example, they are more cartilaginous. Cuvier states, in general, that the bones of reptiles contain more gelatine than those of the mammalia. Caldesi asserts, that there are no medullary cavities in the tortoise; according to Cuvier, there are considerable ones in the crocodiles. *Leçons d'Anat. Comp.* tom. i. p. 110. They have never been seen tinged with madder.

The Head.—A very diminutive cranium, and enormous jaws, make up the head in this class.

As the brain of reptiles and fishes occupies only a small part of the cavity of this cranium, no important consequences can be deduced from its shape and size. In the tortoise, this cavity is large, narrow from right to left, elevated anteriorly and depressed posteriorly. Its lateral parietes are almost vertical, and its base is parallel to the palate. The external form of the head, and its apparent magnitude, are occasioned by the accessory bones, between which and the cranium there is a large space occupied by muscles and glands. The greatest part of the skull is occupied by the large lateral hollows, holding the eye, and the powerful muscles, that move the lower jaw.

The small size of the cavity of the cranium, with respect to the external bulk of the head, is still more extraordinary in the crocodile. In an individual four metres long (between thirteen and fourteen feet), that cavity will hardly admit the thumb, and the area of the section of the cranium is not one-twentieth part of that of the whole head. (See a section of the skull of a crocodile in the *Annales du Muséum*, tom. x. pl. 4. fig. 5.) The length of the cranium is not one-fifth of the length of the head in the gavials (*longirostres*, Cuvier); and it is less than one-fourth in the alligators or caimans (*alligatores*, Cuv.), and in the true crocodile (*crocodili*, Cuv.) The figure of the section is oblong, rather larger anteriorly, and descending posteriorly. There is a considerable depression for the pituitary gland. Its breadth is equal to its height; and the lateral parts of the head, as in the tortoise, cover only the temporal fossæ.

The relative size of the cranium and jaws undergoes a very remarkable change, in proportion to the gradual development of the crocodile. The head, when it comes out of the shell, is thick and rounded, and the forehead prominent; see

Seba.

Seba, *Thefaurus*, tom. i. pl. 104, figs. 3 and 6; and Blumenbach's *Abbildungen*, N° 27. The eyes are now equidistant from the end of the snout, and the posterior extremity of the head; of which the cranium forms nearly one-third. When we look at the adult animal, we are astonished to find the frontal prominence gone, leaving the head quite flat, and the jaws so elongated, that the eyes are three times farther from the end of the snout than from the back of the head; and the proportion of the face to the cranium is 20 instead of 3 to 1. Geoffroy St. Hilaire in the *Ann. du Mus.* vol. x. p. 77.

The camelion exhibits also a great disproportion between the cranium and the rest of the head. Its brain, according to the description of the Parisian dissectors, does not seem larger than a pea; and the remainder of the head, which is of considerable size, consists of the large maxillary bones, the orbits, and immense temporal fossæ, which, not being separated by any partition, give the cranium a very singular appearance. *Description Anat. d'un Cameleon*, &c.; or *Blasii Anat. Anim.* vol. i. p. 14.

The cranium of frogs and salamanders is almost prismatic.

The French naturalists have furnished excellent descriptions and engravings of the heads of various crocodiles. It will be as well for us to enumerate here the sources of information concerning the osteology of this animal altogether, and to give a few references to good figures of the skeletons of other reptiles.

There are tolerably good representations of the crocodile's skeleton (the East Indian) in Grew's *Museum Societatis Regiæ*, and in Faujas St. Fond, *Histoire de la Montagne de St. Pierre de Maestricht*, pl. 44. The head of the crocodile of the Nile (croc. vulgaris, Cuvier), is figured by Geoffroy in the *Annales du Museum*, vol. ii. pl. 37, fig. 2. In pl. 4. vol. 10. of the same work are four figures of the skull to illustrate a paper of Geoffroy St. Hilaire, entitled "Determination des Pièces qui composent le Crâne des Crocodiles;" and pl. 1, of the same volume, contains nineteen figures of the heads of various crocodiles in different views, to illustrate Cuvier's paper "Sur les différentes Espèces de Crocodiles vivans & sur leurs Caractères distinctifs." In the 12th volume of the *Annals*, Cuvier has given his "Observations sur l'Osteologie des Crocodiles vivans," with two plates, in which most of the bones are carefully figured. For the skeleton of the tupinambis, see Cuvier, *Leçons*, v. 5. pl. 3; of frogs, Roefel, *Historia Ranarum Nostratum*; of the salamander, Latreille, *Hist. des Salamandres de France*; of the tortoise, salamander, frog, camelion, lizard, and a serpent, Daudin, *Hist. Nat. des Reptiles*, vol. 1; of the proteus, firen, and Mexican axolotl, Humboldt, *Recueil d'Observ. de Zool. &c.* t. 1; of the tortoise, Blasii *Anatomia Animalium*; Cuvier, *sur les ossemens fossiles*; and Geoffroy St. Hilaire, *sur les tortues molles*, in the *Annales du Museum*, vol. 14. The skeleton of the tortoise is also figured in Cheselden's *Osteology*; in Coiter's *Lectures Fallopii de Partibus similaribus*, fol. Norib. 1575; and in J. D. Meyer's *Zeitvertreib mit Betrachtung curiöser Vorstellungen allerhand Thiere*. t. 1. tab. 29, 31; t. 2. tab. 62; and the separate parts in Caldesi *osservazioni anatomiche intorno alle Tartarughe*. Firenze, 1687. The skeleton of the common green lizard may be seen in Coiter, pl. 4; in Meyer, t. 1. pl. 56; that of the salamander and water newt, and of several snakes in Meyer: that of the camelion is prefixed to Cheselden's 6th ch. Schneider has figured that of the rana pipa in his *Histor. Amphib. fascic.* 1.

For the form of the head in the different species, a point belonging rather to natural history than comparative ana-

tomy, we must refer to the figures already quoted. The surface is more or less rugous in different specimens; and in many very considerably so; these differences are specific, only where individuals of the same age are compared, for the rugosities increase in size and prominence in each species with the increase of years. The bony substance is often perforated by many small holes, as if it were carious or worm-eaten. The sutures are constant; they are not effaced in the oldest heads observed by Cuvier.

The Cranium.—The cranium of the crocodile, viewed from behind, has the form of a very irregular truncated pyramid; of which the point or narrowest portion is downwards, and the base excavated to lodge the brain, is upwards. This pyramid has three surfaces, one posterior, which forms the occiput, and two lateral. The occipital surface is almost triangular; one of the angles (the apex of the pyramid) is inferior, the other two are superior, and greatly prolonged backwards and to the side, in order to form the enormous articular processes, which receive the lower jaw. Their position is almost horizontal. The foramen magnum is situated in the middle of this surface, and under it the single condyle for articulating the head with the vertebral column.

The sutures depart from the foramen magnum, which divide the occiput into particular bones. The superior part of the cranium is formed by a single parietal bone. Anterior to it there is an os frontis, also single, which forms the roof of the orbits.

The ossa temporum are situated on each side of the parietal bone, and are partly supported by that articular process for the lower jaw, already mentioned.

A small arch on each side, different from the zygoma, leaves between it and the parietal bone a large round hole, which perforates the temporal fossa. The arch is partly formed by a process of the os temporum, and partly by a particular bone articulated to the junction of the parietal and frontal. The particular bone occupies the place of the post-orbital process of the os frontis in the mammalia; for it descends behind the orbit to join the cheek-bone; and with it finishes the frame of the orbits.

The unusual configuration of the whole head in the crocodile necessarily involves very extraordinary modifications of the individual bones, which it is in many cases exceedingly difficult to refer to their corresponding ones in the crania of the mammalia. For a more minute account of this matter, which could not be easily understood without plates, we refer to the memoirs and engravings, already quoted, of Geoffroy and Cuvier.

A cranium similar to this of the crocodile, is found in the other lizards, notwithstanding the great differences in the form, proportion, and the direction of the parts. In the camelion, therefore, the foramina, by which the temporal fossa communicate with the cranium, are so large, and the bony edges which form them so thin, that the latter represent three slender branches rising to support the kind of helmet which distinguishes this animal. The articular processes are not directed backwards, but downwards.

The last peculiarity is also observed in the other lizards, but they have not the crests of the camelion, and the upper part of their cranium is broad, like the crocodile.

In frogs and salamanders the cranium is nearly of a cylindrical form, flat superiorly, and enlarged posteriorly; the frontal bones have the shape of an elongated rectangle, and occupy the interval of the orbits. The Surinam toad has the cranium much flatter than the other genera.

The eminences intended to assist in the articulation of the jaw are turned directly towards the sides.

REPTILES.

The structure of the cranium of tortoises bears more resemblance to that of crocodiles than of frogs. The frontal bones form only the roof of the orbits, and the cranium does not pass between these cavities. They are very short, and the parietalia are three times longer. The latter are not confined to covering the cranium. They extend on each side, and form an arch over the temporal fossa. In the sea tortoises this arch is completed by two peculiar bones, which extend from the os parietale to the zygoma, and the anterior of which bounds the orbit behind.

The articular processes are directed downward, as in theameleon. Above these and the meatus auditorius, we find considerable mastoid processes, which are pointed superiorly in land tortoises, but are rounded and marked by a longitudinal furrow in the sea tortoises.

Serpents have two frontal bones almost square, and a single parietal bone. Their cranium advances forward between the orbits, as in frogs. The occipital bone has a process directed backward, and connected with a particular moveable bone, analogous to the square bones of birds, to which the lower jaw, and the arches which form the upper, are articulated.

The general form of the cavity of the cranium of reptiles is oblong, and almost of an equal breadth, being merely a little contracted between the ears. The tortoise has a kind of sella turcica, the four clinoid processes of which are directed forward. The sphenoidal fossa is somewhat depressed in the serpents, but it has no clinoid processes. It is a semilunar depression, the plane of which is situated from before backwards.

The basilar fossa is lower than the other fossæ in the crocodile, and in some tortoises.

Foramina of the Cranium.—The interior part of the cranium is frequently not closed by ossification in reptiles and fishes, and the olfactory nerves pass through a large vacant space, which is not subdivided into particular holes. This at least is the case with theameleon, the iguana, tortoises, the pike, the anarrichas, &c. In others, the olfactory hole is contracted, but is still simple, as in the crocodile. It is double in frogs and salamanders. The rays and the sharks have also two holes, which are considerably removed from each other.

The optic holes are likewise sometimes united into one, as in the crocodile: those of the tortoise are much removed from each other, and are distinguished from the great hole in the front of the cranium, by only a small bony partition. The structure of the cranium in the pike is similar. In the frogs, the rays, the anarrichas, and it should seem in the greater number of fishes, the optic holes are at a great distance from each other, and perforate the sides of the cranium. These animals have no sphenoid-orbital fissure, and the small nerves transmitted to the eyes pass each through a particular foramen.

There is, in general, only one hole on each side for the three branches of the fifth pair of nerves, which, therefore, supplies the place of the foramen rotundum, foramen ovale, and in part of the sphenoid-orbital fissure. This hole, however, is divided into three in the carp.

The meatus auditorius internus exists in reptiles.

The Face.—In the crocodile the face resembles one-half of a cone irregularly flattened on its convex surface. It is chiefly formed by two ossa maxillaria, and two ossa nasi, which are situated almost parallel to each other, and two ossa intermaxillaria, which form the end of the muzzle, and surround the aperture of the nose like a ring.

The bones analogous to the lacrymalia are four in number, two on each side. The os malæ, which is very large,

after forming the inferior, and affording a small process to the posterior edge of the orbit, extends directly backwards to join the great mastoid protuberance: thus the temporal fossa has no communication outwardly; except by a hole which is smaller than the orbit, and the greater part of which is covered by these bones, as by an arch.

The nasal fossæ are continued in a long and narrow tube under the foramen magnum. They perforate the ossa palati, and a particular bone which is analogous to the pterygoid processes of the os sphenoides. This bone is situated almost precisely under the cranium, and is enlarged on each side until it forms a kind of square and almost horizontal wing. An osseous branch unites it laterally to the os maxillare and os malæ, in such a manner that a large hole is left on each side of the arch of the palate.

In theameleon the face is concave superiorly, and bordered by a serrated ridge throughout the whole of its circumference. We observe two holes which communicate with the orbits, and two other oval foramina, which correspond to the incisive holes in the palatine surface. The bones which compose the face are nearly the same as those of the crocodile. The other lizards exhibit still less difference.

The frog and the salamander have the nasal and intermaxillary bones very short, and broader than long, which renders their face round anteriorly. The os maxillare is very narrow, and is scarcely contracted in forming the zygomatic arch. The orbits are large, but have no inferior surface, and therefore communicate with the palatine fossa. The ossa palati form the anterior edge of the orbital fossa inferiorly. They resemble portions of a circle. They are furnished with pointed teeth on their circumference. The canal of the nares is very short in the salamander. There is only a simple hole in the frog.

The face of the Surinam toad is very flat, but the bones are the same as in the frog. The orbital fossæ are oval, and no aperture similar to the canal of the nares can be distinguished.

The face of serpents is rounded nearly in the same manner as that of lizards. Between the os frontis and os parietale, there is a particular bone which terminates the frame of the orbit posteriorly. These animals have no os malæ. We can, however, easily distinguish two ossa nasi, two ossa maxillaria superiora, two ossa intermaxillaria, and some analogous to the palatine arches of birds, which are furnished with teeth, and which are articulated to the bone which supplies the place of the os quadratum, with respect to the lower jaw. Two particular bones unite these arches to the maxillaria superiora.

In those that have teeth, or poisonous hooks, as the viper, the rattlesnake, &c. there are besides two small peculiar bones, articulated and moveable, which support those teeth. They are situated upon the intermaxillary bones and the anterior extremity of the osseous branch, which joins the superior maxillary bone to the arch of the palate.

The face of the tortoise is circular before, and rounded on every side. It is composed of nearly the same bones as that of the crocodile. The intermaxillary bones are, at a very early period, consolidated with those of the upper jaw. The bones analogous to the os malæ are three in number, one articulates with the os temporum and with the two others; it is situated posteriorly, and forms the zygomatic arch. The other two portions are received on its anterior extremity; one extends upwards, and unites with the orbital angle of the os frontis; the other is directed downward,

downward, and articulates with the posterior and external process of the os maxillare superius.

The ossa palati are broad, and form the posterior arch of the nasal fossa.

The bones of the face of tortoises commonly cover each other at their edges, which are refined into thin laminae. It is therefore very difficult to distinguish the sutures.

In the sea tortoises the temporal fossae, which are very deep, are covered by an osseous lamina, which forms a very solid arch above them.

The description of the jaws, and the temporal fossae, is given at the beginning of the account of the digestive organs.

Cavities of the Face.—1. *Nasal Cavity.* It is a broad space in the tortoises, occupying the whole thickness of the snout in front of the eyes, and very short from before backwards. Its front opening is large, and nearly square, with its plane but little inclined; surrounded by six bones. There are two round openings behind, corresponding nearly to the middle of the palate.

In the crocodile it is a long and narrow canal, extending from the end of the snout under the occiput: its bony opening, formed entirely in the two intermaxillary bones, is turned upwards.

Other lizards have the nasal apertures situated nearly as in birds: that is, the front or outer on the side of the snout, and the back or inner in the middle of the palate. They are still shorter in the frogs.

2. The orbit is never separated from the temporal fossa in reptiles by a partition, but merely by a bony branch; and even this is complete only in the lizards and tortoises, not in the frogs, salamanders, or serpents. The plane of its margin is lateral in the tortoises, serpents, and cameleon; it is more or less directed upwards in the crocodile, salamanders, and frogs. The figure varies from circular to triangular. The inferior surface or floor is never complete: either it is altogether deficient, or it is perforated by a very large aperture. The same remarks are applicable to the inter-orbital septum.

The zygomatic fossae are spoken of in the description of the jaws and their movements, under the division of *Organs of the Vital Functions.*

Foramina of the Face.—Where there is no distinction between the orbit and temporal fossa, the sphenomaxillary fissure is of course wanting. There are no internal orbital holes, as the relation between the orbits and nose is altogether different from what is observed in the mammalia.

The crocodile, frog, and salamander, possess a large foramen incisivum. The tortoise has two small ones: the structure of the lizards is not known.

There is no suborbital opening, reptiles having no lips to receive the artery and nerve, which it transmits in the mammalia.

The sphenopalatine canal appears as a simple hole in the os palati.

Motions of the Head.—The articulation of the head of reptiles is considerably behind, but the motions vary in different species.

In the crocodile there is only one condyle, situated at the under side of the foramen magnum: the atlas is formed of two portions; the posterior is shaped like the segment of a ring; the anterior, which is thicker, receives the condyle, and is articulated to the second vertebra: there are two lateral processes, long, flat, and turned backward, which supply the place of transverse processes.

The odontoid process of the second vertebra is short and thick; it is articulated within a cavity in the body of the

atlas. This second vertebra has transverse processes similar to those of the first.

All other lizards have nearly the same conformation; but the condyle seems divided in two by a longitudinal superficial furrow.

The tortoises have likewise only one condyle. In the land tort it is prolonged, and divided into two, as it is in the lizards. In the marine species it presents three articular faces, like a trefoil leaf. As this condyle penetrates deep into the correspondent cavity of the atlas, the lateral motion of the head is much confined. The other motions of the head of the tortoise are those of projection and retraction; they depend upon the flexion and extension of the cervical vertebrae.

The frog, the toad, and the salamander, have the head articulated by two condyles upon the first vertebra, which is almost immoveable.

Serpents have three surfaces, in the manner of a trefoil, close together, upon one condyle, beneath the occipital foramen. The head is not more moveable on the atlas, than the rest of the vertebrae are upon each other.

Bones of the Spine.—The number of vertebrae, and every other attribute of the spine, are more varied in this class of animals than in any other.

In the tortoises, seven vertebrae are assigned to the neck: the first is only a single tubercle, the annular portion of which is very distinct. The surface, by which it is articulated with the head, is formed of three planes; one anterior, and two lateral. The point in which they unite is the most prominent, and to this is attached a strong ligament. The surface which unites it to the next vertebra is a glenoid cavity; the second and the following vertebrae have a prominent longitudinal ridge upon the fore-part of their body. The articular processes descend below the body: there are no spinal processes, except one to the second vertebra, which points forward, and one to the third in the form of a simple tubercle. The two last vertebrae, at a certain age, become ankylosed. There are eight dorsal vertebrae; but they are all ankylosed, together with the ribs and the back-shell, in one immoveable piece. They have, therefore, neither processes nor articular surfaces: they are all narrower in the middle than at the ends. The lumbar and sacral vertebrae are likewise consolidated with the back-shell, but those of the tail are free and moveable. The condyle, which forms the body of these vertebrae at its articulation with the others, inclines backward, and not towards the head, as those of the neck do. There are likewise upon the fore-part of the body, at its base, two small tubercles; but all the processes of these vertebrae resemble those of the mammalia.

In the family of lizards, the crocodile has seven cervical vertebrae, distinct indeed, but so closely articulated as not to be moveable. The processes are so numerous, long, and close, that the animal cannot bend its neck, and the cervical column may, therefore, be regarded as a single piece. This corresponds with the reports of travellers, that the crocodile is unable to turn his head round. The anterior surface of the body is concave, and the posterior convex, throughout the vertebral column of the crocodile. The atlas is composed of six pieces, which appear to continue separate through life: the vertebra dentata has five only. The other cervical vertebrae have on each side two short transverse processes, which serve to support the small ribs or appendices, which limit the flexion of the neck. Each has two pedicles, attached to the two processes just mentioned: the appendix projects into a sharp process before and behind, which touch those of the contiguous vertebrae. The five

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five first dorsal vertebræ have a lateral tubercle for the head of the rib, and another on the transverse process for its tubercle: thus the rib is articulated only to one vertebra. But the first of these articular surfaces is wanting in the remaining ribs, while each of their transverse processes has two articular faces. The same number (seven) is found in most lizards, though theameleon has only two. The sacral vertebræ are very few in every species, and none of them have a large os sacrum.

As frogs have no ribs, no distinction can be formed with respect to the three first orders of vertebræ in them. They have in general eight between the neck and the pelvis, all furnished with pretty long transverse processes. The last are the longest, and touch the ossa ili. In the toads, the transverse processes are very large, and shaped like hatchet blades. The os sacrum consists of a single bone only: it is long, pointed, compressed, and has no coccyx. In the pipa, which has the transverse processes of the second and third vertebræ much longer than the others and almost like ribs, this bone is ossified with the last vertebra.

The salamanders have fourteen vertebræ between the head and the sacrum; they have all nearly the same shape, except the first, which receives the head, and the last, which is articulated to the sacrum. The two extremes of the spine alone want the vestiges of the ribs, which consist of small oblong moveable bones, actually articulated to the transverse processes, which here take a posterior direction. The articular processes are large, and wedged together. The posterior rest upon the anterior, so as to impede the motion of the spine backward. The sacrum consists only of a single vertebra, but there are twenty-seven in the tail.

In serpents, the vertebræ alone constitute almost the whole skeleton. It appears in general, says Blumenbach, that the number of vertebræ, in red-blooded animals, is in an inverse proportion with the size and strength of their external organs of motion. Serpents, therefore, which entirely want these organs, have the most numerous vertebræ; sometimes more than three hundred. (Comp. Anat. p. 118.) In confirmation of this remark, we may observe how numerous the vertebræ are in the elongated fishes, as the eel, and in the whales, as the porpoise, (above one hundred in the former, and between sixty and seventy in the latter). Birds, whose wings give them such vast power of locomotion, have very few vertebræ, if we consider the ankylosed ones as forming a single piece; and the frog, with its immense hind extremities, has a very short spine, consisting of still fewer pieces than that of birds. The vertebræ of this order are nearly of the same form, from the head to the tail: the body, as well as the spinous, articular, and transverse processes, are easily distinguished. In certain kinds, for instance the boæ, the spinous processes, which are continued throughout the whole length of the back, are separated from each other, and allow reciprocally a motion sufficiently conspicuous. Wherever this disposition of the spinous processes prevails, the body of the vertebræ, on the side next the belly, presents only an obscure projecting line. In other kinds of serpents, as for example the rattlesnake, the spinous processes are long, and so large as to touch each other. They have, for their basis, the articular processes, which lie on each other like tiles. In consequence of this structure, the motion of the spine towards the back is very circumscribed, but its motion towards the belly and sides much augmented. The bodies of the vertebræ play very easily in these directions upon one another, and are armed with a sharp spine tending towards the tail, which only obstructs their motion when it might produce a luxation. The first vertebræ differ from those of the rest of the body,

only in having the rudiments of the ribs much smaller: there is no neck in these animals. The vertebræ of the tail differ no farther than in having no ribs, and that their spines, both ventral and dorsal, are double, or form two ranges of tubercles. The articulation of the bodies of the vertebræ with each other is very remarkable: the anterior part of the body of the vertebra presents a smooth hemispherical tubercle, and the posterior part a corresponding cavity; so that each vertebra becomes connected to those next it by a sort of knee-joint. This mode of articulation fully explains the motion of reptiles, which is performed winding from side to side, and not up and down, as it is represented by painters.

Table of the Number of the Vertebræ in Reptiles.

I. Oviparous Quadrupeds.

Species.	Vertebræ of the Neck.	Vertebræ of the Back.	Vertebræ of the Loins.	Vertebræ of the Sacrum.	Vertebræ of the Tail.
Turtle - - -	7	11	0	3	20
Crocodile - - -	7	12	5	2	34
Tupinambis - -	7	18	4	2	104
Iguana - - -	5	11	9	2	72
Cameleon - - -	2	17	3	1	69
Salamander - -	1	12	1	1	26
Frog - - - - -	10 in all.				
Pipa or Surinam toad, 8 in all.					

II. Serpents.

Species.	Vertebræ to which Ribs are joined.	Vertebræ of the Tail.
Viper (berus) - - - -	139	55
Spectacle snake (naia) -	192	63
Garter snake (natrix) - -	204	112
Amphisbæna - - - -	54	7
Boa (constrictor) - - -	252	52
Common snake - - - -	244	More than 60.
Rattlesnake - - - -	175	26
Slow worm (anguis fragilis)	32	17

Of the Ribs and Sternum.—The thorax of reptiles is very various in its structure. Frogs have a sternum, but no ribs; serpents have ribs, but no sternum; tortoises have the ribs ossified to the back-shell, and the sternum included in the breast-plate; the crocodile and lizard have perfect ribs, but their sternum is almost entirely cartilaginous. In the crocodile, the first portion of the sternum is ossified and elongated. It receives the two clavicles. The remaining part is entirely cartilaginous. It is united with the os pubis, and sends off eight cylindrical cartilages to the parietes of the abdomen. This structure, constituting a species of abdominal sternum, apparently for supporting the viscera, is quite peculiar to the crocodile. The ribs are twelve in number, the two first and two last of which are not attached to the sternum. The intermediate ribs have upon their posterior edges cartilages partly ossified, which supply the place of the angles of the ribs in birds. All the posterior ribs, beginning at the fifth, are only articulated to the transverse processes of the vertebræ, which are of great length. The five first articulate with the vertebræ at two points, one on

its body, and the other on the transverse processes. The iguana and the tupinambis have only the upper part of the sternum ossified: it is broad, and receives six ribs and the clavicles; the other ribs are free. The camelion possesses likewise the upper portion of the sternum; but almost all the ribs have cartilages, which extend to the middle line, and are there united to the opposite ones. Frogs, though they have no ribs, have nevertheless a very conspicuous sternum. It forms on the anterior part a cartilaginous appendix, furnished by a disk situated below the larynx. It next receives the clavicles, and then expanding, it terminates at last in another disk situated under the abdomen, and which affords an origin for muscles. There is a peculiar bony cyst of unknown use on the internal surface of the sternum, in the rana pipa.

The salamander has ribs, so short that they seem to be the transverse processes of the vertebrae; they have only one point of articulation, upon which they have but little motion. These rudiments of ribs are twelve in number on each side. This reptile has, properly speaking, no sternum, but its place is partly supplied by the bones of the shoulder, as we shall presently see.

The skeleton of the chelonian reptiles exhibits to us what appears on the first view as a completely anomalous organization. In the bony house which these animals carry about with them, there is such a deviation from the ordinary figure, connection, and position of the parts, composing the skeleton of other vertebral animals, that a hasty view would lead us to infer that the general model to which Nature in all her modifications of form and position ever adheres, has been completely lost sight of, and another substituted in its place. This inference would be altogether incorrect: a more accurate examination enables us to discover in the external bony shells of these singular creatures, all the osseous pieces which belong to the chest of a mammiferous animal or bird; so that no essential part is wanting in their thorax, and the singularity depends merely on the more or less complete ossification of the whole pectoral case, and the peculiar forms resulting from this circumstance. Thus, instead of the anomaly, which a hasty glance leads us to anticipate, we actually discover, on the contrary, a new proof of the constancy, with which an original model is retained throughout whole classes of animals, even under the widest differences of external form, as if Nature, having fixed on one general principle of organization, would not be at the trouble of inventing others, but rather chose, by the strangest modifications, to accommodate the organs to new situations and forms. It is a new illustration of that principle, in conformity to which the fin of a whale contains all the bones of an upper limb of a quadruped, the wing of the bat the regular digital phalanges, the fin of a penguin or seal the usual bones of the extremities of a bird or mammiferous animal, &c.

The bones of the chest in the tortoises form a more or less convex shield-like covering, which constitutes the upper surface of the animal; we call it the upper shell (carapace, *bouclier*, &c.); and a nearly flat portion adapted to its concavity below, constituting the inferior surface of the animal: this is the under shell (*plastron*).

The back shell is formed by the expansion of eight ribs or osseous staves, which arise from the joints of the vertebrae, and terminate in a border that surrounds the whole shell: these bones are united together by real sutures, situated transversely. Above, and all along the middle part of the shell, we observe a row of little osseous plates, almost square, intimately connected together, and to the plates formed by

the ribs, by synarthrosis, and equal in number to the vertebrae. These plates represent the rings and spinous processes of the vertebrae. The osseous margin is made up of a great number of pieces, (eleven on each side, and a single one in the middle, before and behind, therefore 24 in the whole,) folded together, which by their union form an edge or border with three surfaces, *viz.* the superior, which belongs to the back shell; the inferior, which is joined to the breast-plate by a very thick leather-like skin; and the internal, which presents a groove for the reception of the extremities of the ribs. These pieces, which Geoffroy compares to the sternal or cartilaginous portion of our ribs, are wanting in the soft tortoises, (*trionyx*, Geoff.); or at least remain constantly cartilaginous or membranous, so that the middle only of the upper shell is sustained by an osseous disk.

The turtles, and the soft tortoises, are the only genera in which the ribs, confounded in the upper shell or carapace, are nevertheless distinct, both by a prominence very apparent on the inside of the shell, and by a free unattached portion of their ends projecting beyond the edge of the shell. But the osseous disk, composed of articulated pieces, and already mentioned, extends round the ribs in the turtles, receiving their ends, but is wanting in the soft tortoises. Its solidity is increased in the former by the great plates which cover it, while it remains flexible in the latter, and is covered only by a species of epidermis.

The ossification of the intervals of the ribs, forming the carapace, is perfected gradually, and is not finished until long after that of the ribs themselves: it generally advances from the middle towards the edges. Thus, in a young turtle the ribs will be found separate from each other, towards their external extremities, for half their length; while in an adult individual of the same species, the anterior ribs are united throughout, while the intermediate ones are separated only through about one-sixth of their length.

The carapace is always oval and pointed behind in the turtles; elliptical and gibbous in the land tortoises; elliptical and flatter in the fresh-water tortoises. Its surface is rough in the soft tortoises; elevated into various prominences in the chelydes and the serpentine, and more or less smooth in the others.

The margin of the upper shell assumes a different appearance at its anterior part; it is there a square piece of bone, convex above, and concave below, which sustains a spine for the attachment of muscles. Its anterior edge has more the form of a crescent (*lunula*); there are also some little peculiar pieces above the tail.

The breast-plate of the tortoise is its sternum; and when deprived of the thick skin that covers it, exhibits, in some species, only one solid plate, formed of several pieces, united by synarthrosis: in others, this plate is perforated quite through, and formed of several bones, some of which are situated in the middle line between the anterior and posterior part, while others are placed laterally, and fastened together by the help of the former, which support them. For further information concerning the osseous fabric of the chest in these reptiles, two memoirs in the 14th vol. of the *Annales du Muséum* may be consulted; "Sur les Tortues molles, par Geoffroy St. Hilaire;" "Sur les ossements Fossiles de Tortues, par Cuvier."

In the draco volans the ribs form the skeleton of the wings, or those expansions of the integuments between the front and back limbs, which are so called. The five posterior ribs are elongated and bent backwards for that purpose. Here progressive motion is performed by these ribs; but they are superadded for this purpose, and make no part of the organs of respiration. The animal cannot

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in truth be said to fly: its lateral membranes act like a parachute, and enable it to take long leaps.

The ribs are usually articulated to the vertebræ by means of a convex surface, which moves upon a slightly concave one formed in two of the vertebræ, so that the hollow receiving each rib is situated between two vertebræ of the back. But in the snake tribe the head of the rib has two slightly concave surfaces, which move upon a convex protuberance belonging to each vertebra; so that the rib rests on a single vertebra. The consequence of this peculiarity is, that the ribs do not interfere with the motions of the individual vertebræ, and thus that the latter are left free to execute those movements on each other, which take place so extensively in the progression of serpents. The articulations of the vertebræ to each other, and to the ribs, are represented of the natural size from the skeleton of a large boa, in the *Philos. Transf.* 1812, pt. 1. pl. 6.

We have already seen the ribs, instead of contributing to the business of respiration, employed for purposes of locomotion in the draco volans. They are still more extensively employed for the same purpose in the serpent tribe, in which they amount sometimes to 250 pairs, as observed by sir Everard Hume. These bones, in all snakes, are continued to the anus, while the lungs seldom occupy more than one-half the cavity covered by the ribs. The hind ribs can only be employed for the purpose of progressive motion, and thus correspond to the elongated ribs of the lateral membranes in the draco volans.

The ribs of a snake may be seen to move forwards successively when the animal is in motion, like the feet of a caterpillar, and the ends of these bones can be distinctly felt on the palm of the hand, as the animal passes over it.

At the termination of each rib is a small cartilage in shape corresponding to the rib, only tapering to the point. Those of the opposite ribs have no connection, and when the ribs are drawn outwards by the muscles, are separated to some distance, and rest through their whole length on the inner surface of the abdominal scuta, to which they are connected by a set of short muscles: they have also a connection with those of the neighbouring ribs by a set of short straight muscles.

When the snake is going to put itself in motion, the ribs of the opposite sides are drawn apart from each other, and the small cartilages at the ends of them are bent upon the upper surfaces of the abdominal scuta, upon which the ends of the ribs rest; and as the ribs move in pairs, the scutum under each pair is carried along with it. This scutum, by its posterior edge, lays hold of the ground, and becomes a fixed point, from whence to set out anew. This motion is beautifully seen, when a snake is climbing over an angle, to get upon a flat surface.

The coluber and boa, having larger abdominal scuta, which may be considered as hoofs or shoes, are the best fitted for this kind of progressive motion; there is, however, a similar structure of ribs and muscles in the anguis and amphisbæna. In the anguis the ribs are proportionally weaker, and as these have nothing to correspond to the scuta, this mode of progressive motion is probably less necessary to them. See "Observations intended to shew that the progressive Motion of Snakes is partly performed by means of the Ribs," by sir Everard Hume, *Philos. Transact.* 1812, pt. 1. pag. 183, with figures. We are also indebted to sir Everard Hume, in conjunction with Dr. Ruffel, for describing more particularly a fact noticed by Blumenbach, (*Comp. Anat.* p. 117.), viz. an adaptation of certain ribs in the cobra de capello (coluber naia, L.) to the accomplishment of a particular mechanism in that animal.

This serpent is called the hooded snake, from a power of expanding the skin of the neck, which is effected by the motions of the ribs. In other serpents, the ribs, from the first vertebra to those of the middle of the trunk, gradually increase in length; thence they gradually shorten or decline, to near the end of the tail, where they disappear, or are transformed into short eminences. In the naia, the cervical ribs gradually lengthen to the tenth or eleventh, after which they successively shorten to the twentieth. Again increasing in length, they are, at the middle of the trunk, nearly as long as the middle cervical ribs, and then declining as in other serpents, disappear on the tail.

The first twenty ribs, instead of bending equally with the others towards the belly, go out in a lateral direction, having only a slight curvature, and when depressed lie at the side of the spine upon one another. The first is shortest: they lengthen to the tenth, and are again shortened to the twentieth; so that, when they are extended, they represent an oval figure, of which the spine is the middle line or long axis. In the extended state of the ribs, the skin of the back is brought over them, forming the hood; and in their depressed state it recedes. From the rounded form of the hood, the skin has the appearance of being inflated; but the most careful examination did not discover any communication between the trachea or the lungs and the cellular membrane under the skin. See "Remarks on the voluntary Expansion of the Skin of the Neck in the Cobra de Capello," &c. by Pat. Ruffel, M.D. and Everard Hume, esq. *Philos. Transf.* 1804, pt. 2. pag. 346.

The existence of ribs has been denied in the firen lacerina, and proteus anguinus: they have in truth merely very insignificant rudiments of ribs, that might be easily overlooked. These have nothing to do with the respiration of the animals, indeed they are too small to answer any purpose. See the description of these animals at the end of the present article.

Such rudiments of ribs are said to exist in the genus cæcilia, among serpents.

Bones of the Shoulder.—In oviparous quadrupeds the glenoid cavity of the shoulder is partly composed of the scapula, and partly of the clavicle. The scapula, which is elongated, has no spine; it contracts and becomes thicker towards the neck. The clavicle is simple, short, and flat, and united to the sternum in the crocodile and lizards. It is broad, and almost square, in the iguana andameleon; in the tupinambis it is oval, and very large and long between the front and back, and has two unossified parts. The frog and toad have two clavicles to each shoulder, attached to the two extremities of the sternum. The scapula is bent, and composed of two articulated pieces, with the superior one inclined towards the spine. The same conformation obtains in the Surinam toad. The anterior clavicles appear to correspond to the os furciforme of birds. The clavicle, the sternum, and the first piece of the scapula, are ankylosed together. The salamanders have the shoulder formed in a most singular manner, the scapula, clavicle, and sternum, consist only of a single bone, which receives the head of the humerus. The shoulder is almost all cartilaginous, but the part answering to the scapula is more distinct than the rest. It inclines towards the spine, where it receives the muscles by which it is moved. The clavicular part is directed towards the head; that which supplies the place of the sternum turns towards the breast, but without uniting with the bone of the opposite side; the part on the right side slides over that on the left. This conformation allows a greater dilatation of the breast in respiration. The tortoise has

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has also these three bones, which unite to form the glenoid cavity, and correspond with the scapula, fork, and clavicle. But as their respective disposition is very remarkable, it appears necessary to give a particular description of them. One of the bones extends from the base of the rudiment of the first rib, to which it is fixed by a ligament, as high as the humeral cavity, where it is intimately connected with the other two. The second bone may be considered as the continuation of the first, which it joins at the humeral cavity, of which it forms part. Its other extremity is attached to the breast-plate, and strong ligaments likewise unite the extremity to that of the posterior bone. These two bones, thus united, are slightly bent outwards, so as to leave between them and those of the opposite side, an oval space, through which the œsophagus, the trachea, and several muscles, pass. The first seems to correspond to the clavicle, and the second to the os furciforme. Finally, the third bone of the shoulder is situated below the abdominal and thoracic viscera, nearer the breast-plate. It is long, and extends from the humeral cavity, of which it forms the lower part, as far as the abdomen. It seems to supply the place of the scapula by the number of muscles inserted into it, but its situation is just the reverse of that bone. A very strong ligament unites this bone to the second.

Bone of the Arm.—The humerus of the tortoise has a very remarkable shape. As in birds it is articulated at once to the scapula, clavicle, and os furciforme, by a large oval head, the greatest diameter of which lies in the direction of the flatness of the bone. A considerable eminence rises above this large head, which, by its curvature and its uses, has some relation to the olecranon, a process which, in this animal, the bone of the fore-arm wants. Below the head there is another eminence, less projecting, but more rough, which likewise serves as a point of insertion to some muscles, and supplies the place of the little tuberosity. The rest of the body of the bone is flattened and narrow towards the middle. In the crocodile, the humerus is round, but a little bent like an S in its whole length. At the extremity that joins the scapula, it resembles the tibia; its head, instead of being round, is flat; and its tuberosity, which is single, is anteriorly in the form of a ridge, and somewhat inclined inwards. In the other lizards, and in frogs, the humerus exhibits nothing peculiar. Serpents having no limbs, have consequently no humerus.

Bones of the Fore-arm.—The humerus of the crocodile terminates in two round tubercles. The hollow head of the radius turns upon the external one. Between them the round head of the ulna is situated, but it has neither olecranon nor sigmoid cavity. In the upper part it is the largest of the two bones, but the smallest below. There is nearly the same conformation in the camelion, but the bones are more elongated, and the inferior head of the radius is less than that of the ulna. In the frog the single bone of the fore-arm is articulated by a concave head, with a large round tuberosity on the base of the humerus, between its two condyles. On each side, where the lower part of this bone becomes larger, we observe a furrow, which is the only vestige of a distinction into two bones. Troja has pointed out a singularity in the structure of the bone of the fore-arm and of the leg in frogs and toads. These bones consist of a single piece, which is solid in the middle, but divided at either extremity into two conical portions, having manifest medullary cavities. See Memoria sopra la struttura singolare della tibia e del cubito nelle Rane e nei Rospi, in his Sperimente intorno alla Rigenerazione delle Ossa. Nap. 1779, p. 250, t. 7, 8.

The two bones of the fore-arm of salamanders are situated

one above the other. The ulna, which is the lowest, and somewhat longest of the two, has no olecranon; but there is a sort of rotula in the tendon of the extensor muscles. The ulnar extremity of the humerus is much enlarged. The articulate surface which terminates it is convex, and permits the radius and ulna to turn together in every direction. The two bones of the fore-arm in the turtle are always in a forced state of pronation. The radius, which is much longer than the ulna, and fixed to it by a cartilaginous substance, is the lowest, and extends even under the carpus. These two bones much resemble each other in the humeral extremity, being formed by a single concave surface received upon a correspondent pulley of the humerus. Their articulation is such that it allows them to move together laterally, and a little upward and downward in the action of swimming.

Bones of the Hand.—The frog, the toad, the salamander, have three ranges in the carpus. The first consists of two bones, one radial and one ulnar; the second consists of three bones, the largest of which bears the rudiment of a thumb with two joints; the third range has likewise three bones. The second fingers proceed from the first of these bones; the fourth finger is articulated with the second bone; the middle finger articulates with both bones; the little finger joins the third bone. The first range touches the third inferiorly, because the second is cuneiform. There is no bone without the range. In the mud tortoise, the first range is a single bone, which separates the radius from the ulna: the second range consists of two bones, and a small one out of the row, situated on the ulnar edge: the third range consists of five bones, one for each bone of the metacarpus. The sea tortoise has three bones in the first range, the ulnar bone being the longest. The two anterior bones do not advance much farther. The third range consists only of three bones for those of the metacarpus, and one small bone out of the row, situated upon the radial side.

In the crocodile, the first range consists of two long parallel bones. It has besides two little external bones without the range on the radial side. The number of the phalanges varies in these animals. The crocodile has the hand rounded. It has two phalanges to the thumb, three to the second finger, four to the middle and fourth fingers, and only three to the little fingers.

The camelion has three fingers on one side, and two on the other, which form, with the three opposite to them, a kind of forceps. The number of the phalanges is the same as in the crocodile, with the exception of the little finger, which has four. In the salamander the little finger is obliterated, and the thumb has only two phalanges.

The frog has only one phalanx to the thumb. The two following fingers have only two phalanges. The other two fingers have three.

The hand of the sea tortoise is long, and compressed in the form of a fin; there are two phalanges to the thumb, three to the three succeeding toes, and two only to the last. A similar conformation is observable in the mud tortoise; with this exception, that its hand is rounded.

Bones of the Pelvis.—In the turtle, that part of the os innominatum which corresponds to the pubis, is the most considerable. It proceeds from the cotyloid cavity by a thick portion, which comes forwards and widens into a thin flat lamina, divided into two parts; one is turned towards the middle line, by which the two corresponding bones are united; the other is free, and is directed to the external side. The portion which corresponds with the ilium is short, narrow, and thick; it rests on the shell, and is joined to the sacrum; finally, the portion which is analogous to

the ischium is turned backward and downward, and forms the real osseous circle of the pelvis. This conformation is so singular, that the parts of the pelvis of the turtle, when the whole is viewed out of its natural position, may very easily be mistaken for one another; for the pubis resembles the ilium, the ischium the pubis, and the ilium the ischium. There is, besides, another very remarkable peculiarity in the pelvis of tortoises; the ilium, and consequently the whole mass of the pelvis with which that bone is united, is moveable on the vertebral column.

In the crocodile, and in the tupinambis, the disposition of the pelvis has a great resemblance to that of the tortoise. In the crocodile the pubis receives the ventral ribs. In the camoleon and the iguana it is narrow, and the bones of the ischium form, by this union, a projecting crest. In the frog, and in the Surinam and common toads, the ossa ilii are much elongated; the pubis and the ischium are short, and united in a single solid piece, the symphysis of which forms a crest, more or less round. In the salamander, the conformation is precisely the same. The ossa ilii are narrow, and almost cylindrical; and the ossa pubis completely united with the ischium, form only a large bony plate without any hole.

Thigh-Bone.—The femur of oviparous quadrupeds resembles that of other animals; it has, however, a double curvature, more or less evident. In front it presents a convexity towards the tibial extremity, and a concavity near the pelvis. In the tortoise the trochanters are well defined, but they are not to be found in the lizards and frogs. The figure of the femur is in general round, except in the Surinam toad, in which it is very flat.

Bones of the Leg.—Oviparous quadrupeds have the tibia and fibula distinct and separated from each other throughout their whole length. These two bones are nearly of the same magnitude in the tortoises and lizards. The frog has but one bone, but a furrow seems to indicate the union of the tibia and fibula. In these animals the tibia and fibula are, for the most part, directly articulated to the thigh-bone.

Bones of the Ankle.—The astragalus is articulated to the tibia, and the os calcis to the fibula in all reptiles. The tarsus of the crocodile has five bones, viz. an astragalus, an os calcis, two cuneiformia, answering to the two middle metatarsal bones, and one out of the range, which answers to the external metatarsal bone. There are four metatarsal bones. The bone situated without the range serves to support the little toe in the mud tortoise. In the sea tortoise it is very flat. The os calcis and astragalus are very small. In frogs, the astragalus and os calcis are very long, and might at first sight be taken for the tibia and fibula, if they did not form the third joint of the posterior extremity. There are on the fore part, four little cuneiform, five metatarsal bones, and one in the form of a hook, which is very minute. These are similar in the Surinam and common toad.

Bones of the Toes.—The number of the toes varies much in reptiles; as may be seen from the following table.

Number of the phalanges of the toes of reptiles, exclusive of the metatarsal bones, beginning at the pollex, or internal toe.

Crocodile	-	-	-	2,	3,	4,	4.
Lizard	-	-	-	2,	3,	4,	5, 4.
Camoleon	-	-	-	3,	3,	4,	3.
Salamander	-	-	-	2,	3,	3,	3.
Sea tortoise	-	-	-	2,	3,	3,	4, 2.
Mud tortoise	-	-	-	2,	3,	3,	3, 2.
Frog	-	-	-	1,	2,	2,	3, 4, 3.

The saurians present us with arrangements in their extremities, not met with in any of the mammalia. We have species possessing only fore-limbs, or only hind-limbs; others with four limbs, and one toe only on each; and other unusual combinations in the number of toes on the fore and hind-limbs. These circumstances are noticed in those lizards which approach to the form of serpents, and whose small imperfect limbs seem more like rudiments than complete members, serving as intermediate links between the saurian and ophidian orders. See Lacépède in the Ann. du Muséum, ii. p. 351, with figures of a lézard monodactyle, and tetradactyle; and Daudin in his Hist. Nat. des Reptiles, vol. iv. in the history of the genera *Septs* and *Chalcide*. We know nothing, however, about the osteology of these—we might almost say—ridiculous limbs, they are so obviously inadequate to the purpose of locomotion.

Of the Muscles.

Muscles of the Spine.—There are few spinal muscles in frogs. The muscle which is analogous to the ischio-coccygeus is large and thin, and occupies all the space comprised between the long bone of the coccyx and the ilia. Its fibres are oblique, and it serves to draw the coccyx into the direction of the spine. That which is analogous to the lumbo-collalis, arises above the last by a sort of point attached to the coccyx. It extends quite to the head, into which it is inserted, and detaches fibres in its progress to each of the transverse processes, which form a kind of intersection upon its surface. The obliquus superior arises from the head at the margin of the foramen magnum, and is inserted into the transverse processes of the first dorsal vertebra. There is only one small rectus anterior, it arises from the base of the cranium, below the foramen magnum, and is inserted into the first of the transverse processes. The inter-transversales are like the human. The spinal muscles of the salamander much resemble those of the frog; those of the tail are very similar to the muscles of fishes. The spine of the tortoise has no motion except in the parts belonging to the neck and tail. Those of the back and loins, which are ossified together, have no muscles. The muscles of the neck are very different from those of man. The motions they produce are those of elongation, by which the head is protruded from the shell; and those of retraction, by which it is withdrawn, the neck being bent in the form of a Z. The first of the muscles proper to the neck is attached to the under part of the anterior lateral border of the back-shell, and into the transverse process of the first vertebra; it raises the neck and draws it back. Another proceeds from the anterior and middle part of the shell: it is inserted by four fleshy lips, which are separate throughout a considerable portion of their extent, into the articular processes of the third, fourth, fifth, and sixth vertebrae of the neck. It draws the neck back when the head is much extended, and pushes it out when it is retracted. A muscle also arises from the articular processes of the third, fourth, and fifth vertebrae of the neck, by three fleshy portions that afterwards unite, and terminate in two tendons; one of which is inserted into the transverse process of the first, and the other into the spinous process of the second vertebra. This muscle bends the neck upon itself, making it describe a curve, which is convex downwards; this motion brings the head under the shell. A muscle analogous to the longus colli arises from the under part of the body of the second dorsal vertebra, beneath the shell; it ascends along the neck, and furnishes aponeurotic slips to all the transverse processes,

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as far as the second vertebra, where it is inserted. This also is one of the retractors of the head. There are very distinct inter-articulares, which by their action elevate each of the vertebræ, and consequently extend the neck. The transverso-spinalis is situated on the posterior part of the neck: it arises from all the superior transverse processes, and is inserted into all the spinous processes as far as the sixth. Finally, a short muscle proceeds from the upper part of the first dorsal vertebra below the shell, and is inserted into the articular processes of the sixth and seventh cervical vertebræ. This muscle is peculiar to the tortoise, and begins the extension of the neck when the head is concealed within the shell.

Muscles of the Ribs, Abdomen, &c.—In the frog, which wants ribs, and the tortoise, where they are immovable, the muscles which usually have their insertions in them, are in those animals extended to other parts. Thus in the tortoise, whose breast-plate occupies the place of the abdominal muscles, they are inserted into the pelvis, which they move. With respect to those animals, one very remarkable observation may, in general, be made. It appears that the very singular shape of the muscles and bones depend upon each other. Indeed, as the muscles are not placed upon the bones, they have not, if we may be allowed the expression, fashioned them; and the want of motion in the bones, which has given an unnatural figure to the trunk, has also given to the muscles other forms and other uses. The abdominal muscles of the frog present nothing peculiar, except that the skin does not adhere to their surfaces, and that instead of being inserted into the ribs, they are fastened to the sternum by a strong aponeurosis. The same observations may be made with respect to the salamanders.

We have described, in the osteology, the adaptation of the ribs of serpents to the purpose of progressive motion; and now proceed to point out the muscles by which they are moved forwards or backwards, and connected to the abdominal scuta. The ribs are brought forwards by five sets of muscles placed on the outside of the chest, and passing obliquely from above, downwards, outwards, and backwards. 1. One from the transverse process of each vertebra to the rib behind it. 2. The next set arises from the ribs, at a short distance from the spine, passes over two ribs, sending a slip to each, and ends in the third. The third arises from the posterior edge of each rib, passes over two ribs, and is inserted into the third rib behind it. The fourth set passes over one rib and is inserted in the second. The fifth goes from rib to rib.

The muscles carrying the ribs backwards are found on the inside of the chest, and slant from the spine forwards and outwards. A strong set arises from the anterior surface of the vertebra, goes over four ribs, to be inserted into the fifth about its middle. The serrated portions of a strong flat muscle, forming the muscular covering of the abdomen, arise from this part (the middle of the internal surface) of each rib. The right and left muscles unite in a beautiful middle tendon. Thus it is obvious, that the inferior half of each rib (below the origin of the serrated portion just described) is external to the abdominal muscle, and consequently free for the purpose of progressive motion.

The ends of the ribs are connected to the abdominal scuta by a set of short muscles: they are also connected together by short and straight muscles. Another set goes from the heads of the ribs obliquely backwards to be fixed in the skin at the edge of each scutum. See sir E. Hume's paper quoted in the osteology; and particularly

plates 4 and 5 from Mr. Clift's drawings, in which the parts are represented.

There is a complicated muscular apparatus for extending and retracting the ribs, and carrying the skin forwards and backwards in the cobra de capello. The ribs are raised or carried forwards by four sets of muscles, all arising from and inserted in these bones, and directed obliquely from above, downwards and outwards.

The skin of the back is brought forwards on the neck by a large set of very long muscles, arising successively from each of the first twenty ribs, by a tendon, which soon becomes fleshy. The longest is about two inches. They go backwards to be inserted into the skin, which they can bring forwards to a great extent when the ribs have been first extended.

The muscles which carry the ribs back again lie on the inside of the chest under the spine. One set goes from the vertebræ of the neck to the lower edges of the ribs: but they pass obliquely upwards and outwards over three ribs, to be inserted into the fourth, thus acquiring a length of fibre, by which the range of motion produced is much increased. The second set goes from the ends of the ribs forwards to the skin, which they will draw back. The third set from the root of one scutum to the scutum immediately above it, so as to bring it down upon the other. Sir E. Hume's and Dr. Ruffel's paper, and particularly the engravings from Mr. Clift's drawings. Phil. Trans. 1804, pt. 2.

Muscles of the Head.—The muscles of the head of the tortoise cannot be described under names similar to those of mammiferous animals and birds, because the shell affords insertion to the greater number of them. We will, therefore, only distinguish them by the points of attachment. Thus, on viewing the back part of the neck, we remark, 1st, at the anterior part of the back-shell, near the angle of the lunula, a broad muscle, which extends to the lateral and posterior parts of the head, into which it is inserted. It pulls the head backward. 2. Beneath, and from the middle of the anterior lunula of the back-shell, there arises another muscle, which is thin and round, and which, in separating from that of the opposite side, forms an angle like the letter V: it is inserted on the outside of the preceding muscle, and has the same use. 3. A muscle analogous to the splenius capitis rises from the spinous processes of the fourth and fifth cervical vertebræ, by distinct slips, and is inserted into the occipital arch. Its use is to raise the head. 4. A muscle analogous to the rectus major anticus rises from the inferior tubercles of the four vertebræ next to the atlas, and is inserted, fleshy and thick, into the depression of the cuneiform process below the condyle. 5. The trachelo-mastoidæus rises from the inferior tubercles of the second and third cervical vertebræ, by two thin aponeurotic tendons; it is inserted, by a very thick and entirely fleshy portion, into the protuberance that answers to the mastoid process. Its use is to bend the head laterally. 6. Lastly, at the superior part of the cervical spine there is a short muscle, which proceeds from the inferior part of the foramen, formed by the temporal fossa, and is inserted into the spinous processes of the first, second, and third vertebræ of the neck. On viewing the neck in front, we observe the muscle analogous to the sterno-cleido-mastoidæus attached to the strong aponeuroses that surround the humerus at its articulation with the scapula. The lower part of it, for one-third of its length, can only be seen, the remainder being concealed by a muscle composed of transverse fibres, which supplies the place of the mylo-hyoideus, and platysma-myoides. It is inserted into a process corresponding to the mastoid. Its use is to draw

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draw the head inwardly, and to produce a small elevation of the shoulders. The *longus capitis* arises from the third vertebra of the back, and is inserted by a slender tendon into the cuneiform process of the occiput. The frogs have very few of the muscles of the head: most of those which are inserted in it are employed in moving the superior extremities, or are proper to the vertebral column. The muscle analogous to the *obliquus superior* arises from the first transverse processes of the spine, and is inserted into the superior part of the occiput: its direction is oblique from without inwards. That which is analogous to the *rectus capitis anticus minor*, arises from the transverse process of the first vertebra, and is inserted into the basis of the cranium below the foramen magnum. These are the only two muscles proper to the head in frogs: they are similar in the land salamander.

Muscles of the Shoulders.—In the frog (which has no ribs) the *ferratus major* has an extraordinary shape, which appears to be occasioned in part by the want of the cervical vertebrae: it forms three distinct muscles. The first arises from the occiput, near to the foramen magnum. It divides into two bellies, which are inserted into the superior spinal angle of the scapula; one on the internal, and the other on the external side. The second proceeds from the second transverse process, and passes under the dorsal portion of the scapula, towards its spinal edge. The third proceeds from the third transverse process, and passes underneath the preceding, keeping still nearer to the edge. There is besides another muscle proper to the scapula, situated upon its internal surface, between the two constituent parts, which make it appear broken. It appears to draw these two parts closer together, and by its contraction renders the angle they form with each other more acute. There is no muscle analogous to the *pectoralis minor*. The place of the levator, or *angularis scapulae*, is supplied by a very considerable muscle which rises from the base of the occiput; it becomes perceptibly smaller as it approaches the shoulders, and is inserted into the posterior edge of the cartilaginous part of the scapula. The *omo-hyoidensis* is long and thin; it comes from the great inferior horn of the *os hyoides*, and is inserted under the neck of the scapula. The *trapezius* is wanting. The muscle analogous to the *rhomboides* is very thin. It arises from the dorsal processes, and is inserted into the spinal edge of the scapula. There is no *subclavius* muscle. The *sterno-mastoideus* has only one belly, which extends obliquely from the posterior part of the head, behind the ears, to the neck of the osseous part of the scapula. Its action is evidently that of pulling the shoulder towards the head, and raising it up. We shall describe the muscles of the tortoise separately, as they differ considerably from those of other red-blooded animals. They are only three in number. One of them, though very unlike the *trapezius*, is similar in its use; it rises from the lower surface of the back-shell among the ribs, from the second to the fifth. It is very thin, and passes to the external margin of the third bone of the shoulder, which seems to correspond with the scapula. A muscle analogous to the *levator scapulae*, is inserted into the curve formed by the joint of the two first bones of the shoulder. It arises by seven fleshy heads from the transverse processes of the seven vertebrae of the neck. Another little long muscle arises from the inner surface of the back-shell near the sternal extremity of the first rib, and is inserted into the dorsal extremity of the first bone of the shoulder. It is perhaps analogous to the *collo-clavius*.

Muscles of the Arm.—The *pectoralis major* of the frog is composed of two portions, placed one above the other. They produce two tendons which are inserted on each side

of the humeral groove. The *latissimus dorsi* arises from the inferior part of the back, where it is thin. It becomes thicker, and is attached to the broad part of the scapula, which it entirely covers. It is inserted, by a strong tendon, into the internal surface of the humerus, above one-third of its length from its superior end. In the frog there is neither the *supra-nor* the *infra-spinatus*. The *subscapularis* or *coracobrachialis*, (for the muscle of which we now speak supplies the place of both,) arises from the internal surface of the scapula, at its junction with the clavicle, and is inserted into the interior part of the humerus about one-third from the head. The *deltoid* is formed of three portions. The first, which is the longest, and very slender, proceeds from the anterior part of the sternum. The second arises from the union of the clavicle with the scapula, at the internal surface, runs over the bone above the joint, then sends a thin tendon to the first in its passage, and is partly inserted in the *linea aspera*, and partly in the inferior portion of the humerus. The third is distinct; it rises partly from both the scapula and clavicle, and is inserted into the scapular extremity of the humerus. The *teres major* and *teres minor*, are wanting. Besides these muscles, in which we discover an analogy to those of mammiferous animals, there is one which arises from the second transverse branch of the sternum, and is inserted into the inner edge of the groove of the humerus by a broad tendon. It may be regarded as an assistant to the *pectoralis major*. This conformation appears to prevail in the salamander.

If the tortoise has fewer muscles proper to the shoulder than common, it has an extraordinary number inserted into the humerus. That which corresponds to the *pectoralis major* is composed of five portions. Two are superficial; one arises from the edge of the anterior part of the breast-plate, and proceeds to its insertion in the lesser tubercle of the humerus. The other is much more extensive: it rises from a great part of the internal surface of the breast-plate, and is also inserted by a flat tendon in the lesser tubercle of the humerus: but it is prolonged by a fan-like aponeurosis, which extends over the inferior surface of the arm, and even of the fore-arm. One of the three deeper portions of the *pectoralis major* arises from the greater part of the second bone of the shoulder, and is inserted into the humerus, below its scapular articulation; another arises from the expansion of the interosseous ligament, which unites the second bone of the shoulder to the third, and proceeds to join its tendon intimately with that of the preceding portion. Lastly, the third, which is the most deep-seated of all, arises from the superior surface of the third bone of the shoulder, or that which is next the back-shell. Its tendon is conjoined with those of the preceding. The muscle analogous to the *deltoides* is also composed of two portions; one arises from a ridge on the anterior part of the breast-plate; the other, which is its accessory, is placed more deeply, and united to its corresponding muscle. They are inserted by one common tendon into the lesser tubercle of the humerus, which they draw towards the neck in the action of swimming. There is another muscle much deeper seated, which seems likewise an assistant to the *deltoides*. It rises from the dorsal extremity, and all the internal edge of that bone of the shoulder which corresponds with the clavicle, and proceeds to be inserted into the humerus below the lesser tuberosity. On the internal surface of the humerus, we find a muscle rising from the loose extremity of the sternal face of the third bone of the shoulder: it is inserted in the humerus, about one-third from its lower end, by a thin tendon. It bears some relation to the *sterno-radialis* of the frog, and performs the same office.

The levator brachii is a very thick muscle, which arises from the third bone of the shoulder, the exterior edge of which it furrounds, and is inserted into the process of the humerus resembling the olecranon, which it pulls upward and outward. A muscle analogous to the teres major arises from the neck of the third bone of the shoulder, externally, and is inserted into the humerus between the two tuberosities. It pulls the humerus backward. Another muscle, which seems a substitute for the latissimus dorsi, rises from the interior part of the back-shell, to which it is attached obliquely, to the interval between the two first ribs. It is inserted into the body of the humerus behind the greater tubercle, by a flat tendon. It pulls the humerus towards the upper shell, when the animal stands upon all its four feet. A muscle, the use of which seems the same as that of the levator brachii, rises from the whole internal surface of that bone of the shoulder which answers to the clavicle, and is inserted into the whole length of the olecraniform process, or great tuberosity of the humerus. It is very fleshy, and appears to be formed of two portions. Finally, the muscle analogous to the scapulo-radialis, or biceps flexor cubiti, arises from the anterior border of the humeral cavity, and is inserted into the external and superior surfaces of the humerus by a small tendon, which reaches as far as the base of the radius. It extends the member, and brings it toward the head.

Muscles of the Fore-arm.—The frog has, properly speaking, no biceps; its place is supplied by another, and much stronger muscle, situated on the breast, under the pectoralis major, with which it has the same insertions. At the articulation of the humerus it sends out a strong tendon, which passes along the groove of the humerus, and through a tendinous ring, formed by the two parts of the pectoralis major, under the deltoides. It is inserted into the humeral extremity of the radius, and may be named sterno-radialis. There is no brachialis internus. The triceps is composed of three parts, nearly as in man, but they are proportionally larger. There is but one supinator, which arises from the external condyle, and is inserted into the carpus. There is also but one pronator, which rises from the internal condyle, and is inserted into the carpus. In the turtle, these muscles are almost entirely aponeurotic, and produce but very little motion, the place of the member being supplied by a fin, as in the cetacea. In general, the muscles of the humerus produce the motions of the fore-arm.

Muscles of the Hand and Fingers.—In the sea tortoises, which have the carpus compressed and fitted for swimming, the muscles are only simple bands of aponeurotic fibres, which strengthen the several articulations. The muscles of the hand of the frog and salamander are very similar to those of man. Those of the thumb are wanting, except the extensor, which comes from the external condyle, and is inserted into the last phalanges. The other muscles vary very little.

Muscles of the Pelvis.—In the tortoise, the muscle analogous to the quadratus lumborum expands under the back-shell, between the last anterior ribs; it arises from the ilium, towards the articulation of that bone with the os sacrum, which in this animal is moveable. This mobility of the pelvis is assisted by a muscle analogous to the rectus abdominis, which, as we have observed, instead of extending under the belly, is attached under the posterior extremity of the breast-plate by two fleshy portions, the one anterior, the other posterior, which are both inserted in the anterior margin of the external branch of the pubis. There is no psoas parvus in frogs. The quadratus lumborum extends from the long transverse process of the third

vertebra, to the origin of the long bone of the pelvis, which is analogous to the ilium. It is inserted in this bone, which it raises towards the head; their ilium being moveable, like that of the tortoise.

Muscles of the Thigh.—In the frog there is only one glutæus, which is in the place of the medius. It arises from the elongation which supplies the place of the os ilium, and is inserted below the head of the femur. The pyriformis comes straight from the point of the coccyx, and is inserted about one-third from the top of the os femoris. The gemini and the obturator internus are wanting. The quadratus femoris is long. It arises from the posterior symphysis of the ischium, and is inserted into the inner side of the thigh-bone, about one-third from the head. They have neither the psoas magnus nor parvus. The iliacus is proportionally elongated. The pectineus descends to the middle of the thigh-bone. The three adductors have the same origins and insertions as in man. The obturator externus is to be found, though there is no foramen ovale. It arises from the symphysis pubis, and its fibres are attached to the capsular ligament. In the tortoise, the muscles of the thigh produce motions proper to swimming; that is to say, the abduction, the adduction, depression, and elevation of the thigh. The muscle analogous to the adductor longus arises from the symphysis pubis, and is inserted into the internal part of the thigh-bone, about one-third from its tibial extremity. Another muscle, which cannot be easily compared to any in man, arises from the interior of the sacrum, and is inserted into the little trochanters. It is another adductor femoris. A muscle, composed of different radiated fasciculi, arises from the broad inferior surface of the os pubis, and forms a thick tendon inserted into the little trochanter. It occupies the place, and answers the purposes, of the psoas minor. That which is analogous to the adductor brevis arises from the symphysis of the bones of the ischium, and the interosseous ligament of the pubis. It is inserted into the os femoris, below the little trochanter. The muscle answering to the glutæus maximus arises from the spine, opposite to the last rib, and is inserted into the thigh-bone, below the great trochanter. The muscles analogous to the glutæus medius and minimus can hardly be distinguished from each other. They rise from the internal surface of the os pubis, and are inserted into the great trochanter. That which resembles the obturator internus arises from the internal surface of the ilium, and the superior edge of the cotyloid cavity, and is inserted into the great trochanter.

Muscles of the Leg.—The frog has the thighs round, like those of a man, and the muscles of the leg are very conspicuous. The triceps femoris is formed only of two very distinct portions. The vastus externus and cruralis are manifestly but one. There is no rectus anterior. The biceps flexor cruris has only one belly. It arises from the posterior and internal part of the ilium, and is inserted into the exterior and anterior surface of the tibia, for there is no fibula. The semi-membranosus is like the human; but the semi-tendinosus is composed of two bellies, one of which rises from the symphysis pubis, and the other from that of the ischium. The sartorius is situated exactly in the front of the thigh, without any obliquity. There is nothing remarkable in the gracilis. There is no distinct popliteus. Some differences occur in the muscles of the leg of the tortoise. These have a relation to the faculty of swimming, for which its extremities are fitted. The muscle which takes the place of the semi-membranosus arises from the interosseous ligament of the pelvis, and proceeds to form a strong aponeurosis at the inferior part of the leg. That which corresponds to the semi-tendinosus arises also from the interosseous liga-

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ment; it passes under the ham, and is inserted into the tibia, which it bends. That which is analogous to the sartorius arises from the os pubis, near the interosseous ligament, and passes over the knee, to be inserted into the tibia, which it extends. A muscle composed of two fleshy portions, both of which arise from the lateral parts of the sacrum, is inserted below the head of the tibia, and bends the leg. In its action, it much resembles the biceps, from which, however, it differs with respect to its attachments. Another muscle, resembling the fascia lata, and very thin in its fleshy part, arises from the sides of the coccyx. It passes under the skin of the fin, to its insertion, almost opposite to the heel. It bends the leg upon the thigh, and extends the foot upon the leg. The muscle analogous to the biceps arises from the sacrum and ilium. It goes to the external surface of the leg, where it is inserted into the fibula. The extensor of the leg presents nothing particular. The muscle analogous to the rectus anterior arises from the internal surface of the pubis, and joins the common tendons of the extensors.

Muscles of the Ankle.—In the frog, the gastrocnemius has only one belly; it has, however, a small tendon, by which it is inserted into the outward side of the head of the tibia. Its tendon runs under the heel, and there sliding over a sesamoid bone, expands itself under the foot, to form the plantar fascia. There is neither soleus nor plantaris. The tibialis anticus rises by a strong tendon from the lower part of the os femoris. About the middle of the tibia it divides into two bellies, one internal, the other external. The tendon of the first is inserted into the tibial base of the long bone of the tarsus, and that of the second into the same bone, a little more outwardly. An assistant to this muscle arises from the middle and anterior part of the tibia, and proceeds to the internal side of the base of the long bone of the tarsus. The tibialis posticus resembles the human, but it is only inserted into one bone of the tarsus, viz. that which is long, and situated at the inner side. There is but one muscle, to which the term peroneus can apply. It arises by a slender tendon, from the external condyle of the thigh, and is inserted into the base of the tibia, on the outside, by two tendinous portions, one of which extends to the bone of the tarsus. It extends the leg with respect to the thigh, or, more properly, the thigh with respect to the leg. Besides these muscles, which extend from the leg to the foot, there is another which arises from the metatarsal extremity of the tibia, at its internal edge, passes between the two bellies of the tibialis anticus, and proceeds very obliquely to its insertion, at the digital extremity of the long bone of the tarsus, on its inner side. In the sea tortoise, the muscles of the feet are supplied by aponeurotic fibres, somewhat fleshy, which serve only to strengthen the articulations, and keep the fins properly extended.

Muscles of the Toes.—There is no extensor longus digitorum in the frog; neither is there any flexor proprius pollicis. The extensor brevis digitorum is very distinct, it arises from the whole length of the long external bone of the tarsus, and extends obliquely to all the four toes, the last excepted. It is inserted into the last phalanges. There are superior and inferior interosseous muscles, which are very apparent, to the number of ten. Their direction is very oblique. The flexor communis digitorum is situated under the long bone of the tarsus, on the inner side, and is covered by the aponeurosis of the gastrocnemius. When it reaches the little bones of the tarsus it divides into five tendons, which receive, at their inner side, assistant fleshy fibres, apparently proceeding from a muscle situated below the long bone of the tarsus, on the inner side. It may per-

haps represent the flexor longus. In the sea tortoise all these muscles have their places supplied by bundles of aponeurotic fibres.

On the Support of the Body, and its Motions in Progression.—*Standing* is an attitude common to all animals, but the circumstances attending it differ very considerably. In most of the oviparous quadrupeds, the knees and elbows are directed outwards as they stand, and even during their various progressive motions. The posterior members, articulated more in proportion at the sides of the body, are so bent, that the belly descends to the ground, and moves along it.

Turtles rest on their plastron, and on their four flattened, elongated, and fin-like members. They may be compared to seals in their mode of executing movements. They employ their members, either in swimming, or in walking on the sea-shore, or in digging holes in the sand to receive their eggs.

In tortoises, standing is nearly the same as most in other oviparous quadrupeds; and the direction of their body is horizontal. Batracians, and frogs in particular, generally have their body, when at rest, in an oblique elevation; the arms sustaining the front part, while the back remains on the ground. The formation of the posterior limbs does not render them adapted to raise the body in a vertical direction, but merely to push it forwards.

Serpents, in a state of repose, coil up their body in several circles, either rising one above the other, or arranged one within the other; and the head is elevated above this coil. Those which inhabit trees are twisted round the branches. The chalcides and biped lizards may be compared to serpents when at rest, for they are coiled up, and their limbs serve merely to prevent the body from rolling.

Walking exhibits different modifications, according to the number and form of the limbs, and the relative size of the fore and hind-feet. Where they are of equal length, the animals move with great velocity: hence the names of certain species, as *lacerta agilis* and *velox*. When, however, the limbs are too small and weak for the body, the movements are slower, as in the crocodile, the chalcides, and the toad.

The feet of theameleon, and its prehensile tail, make it a better climber than most reptiles.

The limbs being all of nearly equal length in the scinks, they cannot leap well: while the iguanas and tupinambes exhibit considerable agility. The frogs are the great jumpers, from the great length and strength of the hind limbs. But they can hardly walk; moving the front legs only with facility, and being obliged almost to drag the hind ones after them.

Serpents can leap or project their bodies by the sudden extension of several articulations: they form several curves with their body, and then suddenly straighten them, either in whole or in part, according to the leap which they may wish to make.

Creeping, properly so called, belongs only to serpents, and consists of a projection of the body backwards or forwards, produced by the alternate motion of one or several of the lower parts against the ground. The following modifications are exhibited in different instances. 1. Creeping by vertical undulations. 2. By horizontal undulations. 3. By two or three undulations of the posterior third part of the body, while the two anterior thirds are elevated vertically. 4. A sliding kind of crawling, by small undulations formed by the alternate approximation and separation of rows of scales placed transversely under the body.

5. The same kind of motion, produced by the alternate formation and disappearance of folds in the skin of the sides.
6. Without any undulation, merely by the alternate approximation and separation of rings of the body.

The repulsive motions, by which reptiles move their bodies forwards in water, are nearly the same as they employ in jumping; but they must be much quicker. To rise in the water, they must strike back the water below and behind them, and diminish the breadth of their body, as much as possible, by carrying their swimming organs backwards after each stroke. Thus we see the frog, after striking, extend its long hind legs, so as to offer no resistance to the passage of the body through the liquid. The act of swimming offers the following modifications. 1. External swimming (on the surface of the water, breathing air) by vertical undulations, without swimming organs. The serpents. 2. The same by lateral undulations, assisted by the feet. Iguanas, lizards, &c. 3. Swimming under the surface, breathing externally; by four palmated feet, and without tail. *Hyla palmata* (*Rana maxima*, Linn.) 4. The same with four legs and no tail. Frogs properly so called. 5. The same with four feet, an elongated body, and depressed tail. Crocodiles, salamanders. 6. The same by means of four fin-like scaly members, and no tail. 7. Swimming under water, breathing by means of branchiae.

The dragons are the only reptiles capable of flying. Their flight is nearly the same with that of the polatouche, or flying squirrel. Daudin, Hist. Nat. des Rept. t. 1. p. 256.

The Brain.—The brain of reptiles does not fill more than one-half of their very small cranium; hence its relative size to that of the body is very inconsiderable. Its proportion to the body is said to be, in the tortoise $\frac{1}{10}$, in the turtle $\frac{1}{10}$, in the coluber $\frac{1}{10}$, in the frog $\frac{1}{10}$. Blumenbach justly observes, that anatomists have hitherto bestowed but little labour on the brains of the amphibia. The dura mater forms no processes in this order; the interval between it and the pia mater is filled with fluid; the brain is small and simple, and consists of five roundish eminences. Of these, the single one, placed at the front of the medulla spinalis, is clearly the cerebellum, as in all animals which have a nervous system. Whether the four others are to be regarded as the two hemispheres, and the thalami nervorum opticom, is more doubtful. According to Blumenbach, the cerebellum does not exhibit the arbor vitae.

All the parts of the brain of reptiles are smooth, and without circumvolutions. The optic thalami are situated behind the hemispheres, but are not covered by them. They contain each, as in birds, a cavity which communicates with the third ventricle. At the extremities of this ventricle, we observe the anterior and posterior commissure, but there is no soft commissure, nor tubercula quadrigemina.

In the tortoise the hemispheres form an oval. Their anterior part is separated from the posterior by a sulcus, and represents a kind of bulb, which serves as a root to the olfactory nerves. The size of this bulb is about equal to one-third of the hemisphere. The interior of the hemisphere is, as usual, excavated by a ventricle, and contains a substance analogous to the corpus striatum, and which pretty much resembles in its form that of birds.

The optic thalami are not larger than the bulbs of the olfactory nerves. Their form is nearly round. They extend downward and forward, under the hemispheres, to produce the optic nerve. The valve of the cerebrum is situated between them and the cerebellum. No tubercle is

either placed above it or before it, and it gives origin, as usual, to the fourth pair of nerves.

Before the optic thalami, and under the posterior part of the hemispheres, there is a tubercle which corresponds to that we have remarked in birds.

The cerebellum is nearly hemispherical. The fourth ventricle penetrates a considerable way into its substance.

In the frog the hemispheres are longer and narrower. The optic thalami are larger in proportion to the hemispheres. Their ventricle is very distinct. It is the contrary in salamanders, which have the optic thalami very small, and the hemispheres almost cylindrical.

The cerebellum of these two kinds of reptiles is flat, triangular, and lies posteriorly on the medulla oblongata.

In the serpents the two hemispheres form together a mass which is broader than long. The optic thalami are almost round, and one-half less than the hemispheres, behind which they are situated. The olfactory nerve has no apparent bulb. The cerebellum is exceedingly small, flat, and in the form of a portion of a circle.

In all these animals the inferior surface of the brain is nearly smooth. The optic thalami make no projection downward, and the pons Varolii does not exist.

Cuvier assigns, as the distinguishing character of the brain in reptiles, the position of the optic thalami behind the hemispheres. And he states the following as the points in which reptiles, fishes, and birds, differ from the mammalia. The want of corpus callosum, fornix, and their dependencies. Some tubercles, more or fewer, between the corpora striata and the optic thalami. The thalami containing ventricles, and being distinct from the hemispheres. The absence of any tubercle between the thalami and the cerebellum, as well as the absence of the pons Varolii. Reptiles and fishes are distinguished from the mammalia and birds by the want of the arbor vitae.

The brain of the tortoise has been delineated by Caldesi, osservazioni intorno alle Tartarughe, tab. 2. fig. 5: that of the frog by Ludwig, de cinerea cerebri substantia; by Vicq d'Azyr in the Mem. d'Acad. des Sciences, 1783; and by Ebel, in his Observat. Neurol. ex Anat. Compar.; and that of the viper, by Vicq d'Azyr.

Origins of the Nerves.—The olfactory nerves arise, as in birds, from the anterior extremity of the hemispheres. The optic nerves seem to derive their origin from a common eminence, situated under the middle of the hemisphere. The other nerves exhibit no particularities as to their origin.

Distribution of the Nerves.—The olfactory nerve proceeds to the nostrils in this class nearly in the same manner as in birds; but it is longer. The canal which receives it is partly osseous and partly cartilaginous. The two canals have only one common aperture within the cranium. The olfactory nerves of reptiles are generally much more solid than those of the preceding classes.

The two optic nerves are joined together, as in the mammalia. There is nothing worthy of remark about the third, fourth, and sixth pairs.

Reptiles have the three branches of the *fifth pair*. In the sea tortoises the ophthalmic passes, some way, in the dura mater before it enters the orbit. It transmits filaments to the muscles of the globe of the eye, and particularly to the two lachrymal glands. The superior maxillary branch is the largest of the three. It is united to the inferior branch at its origin, but when it reaches the interior of the orbit, it separates from it to take another direction. It passes along the floor of the orbit, describing a very marked curvature, the convexity of which is external. A very great number of filaments proceed from the concave or internal

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sicle, which are lost in the lachrymal gland. The trunk is afterwards divided into two branches:—one internal, which corresponds to the sphenopalatine and sub-orbital nerve. It furnishes filaments to the palate and to the nose; and when arrived at the anterior part of the orbit, it proceeds outwardly and spreads upon the face. The other branch of the principal trunk is external; it passes also upon the floor of the orbit, to which it gives many filaments, and at length issuing from the inferior part of the orbit, it expands upon the face, anastomosing with the other facial nerves.

The inferior maxillary branch proceeds almost vertically downward to the posterior part of the orbit, before the petrous and articular process of the os temporum. In its course towards the lower jaw, it passes between the temporal and pterygoid muscles, to which it sends several filaments. Having arrived at the lower jaw, before the articular surface, it enters the oblong aperture, and divides in the substance of the bone. It forms several branches on the inner part of the jaw, which are lost in the muscles of the tongue, and on the outside some others which ramify under the skin.

The *facial* nerve exists in birds and reptiles, but its size is small, because these animals have no lips, and because their mouth, as well as a great part of their face, is covered with a horny or scaly substance, in consequence of which these parts have but little motion or sensibility. We find, however, some of the branches: they are not indeed easily followed in dissection, but their trunk always exists.

The *auditory* is united to the facial nerve as in the mammalia, and passes into a meatus auditorius, whence its branches go into the ear. They will be described in the account of the ear.

We have nothing remarkable to state respecting the *par vagum* or eighth pair of nerves in reptiles. We observe evidently that it is distributed to the lungs, the heart, the œsophagus, and stomach, and that it forms plexuses on these organs, in the same manner as the great sympathetic nerve produces them round all the arteries of the trunk. On leaving the cranium, the *par vagum* forms decussations with the lingual and glosso-pharyngeal nerves; they afterwards separate from each other: the glosso-pharyngeus is posterior, the *par vagum* in the middle, and the lingual anterior. The *par vagum* does not always come out of the cranium by a single hole; it is formed of two or three filaments, which afterwards rejoin, upon receiving a communicating filament from the glosso-pharyngeus, and one farther down from the lingual; the nerve then augments somewhat in diameter, and descends into the breast.

We have nothing to remark concerning the glosso-pharyngeal and hypoglossal nerves.

Tortoises have eight pair of *cervical nerves*, which are distributed nearly in the same manner as in mammalia. The three last pairs join in forming the brachial plexus. The green lizard has four pair of cervical nerves, but only the two last enter into the composition of the plexus. In salamanders and frogs the cervical nerves cannot be properly distinguished from the dorsal, as the animals have no ribs. A pair comes out between the first and second vertebrae, which is sent to the muscles of the inferior part of the neck, and under the skin that covers them. These nerves also afford some filaments to the shoulder. From this distribution they may be regarded as real cervical nerves. In frogs only two pairs enter into the composition of the plexus. In the salamander there are distinctly four.

We refer to the tables which indicate the number of the vertebrae in reptiles, in order to shew the number of nerves which issue from their foramina. The distribution

of these nerves is the same as in other animals, and to point it out would be only repeating what we have already described in man.

Nerves of the front Limbs.—In the tortoise the three last pairs of cervical nerves, and the first of the dorsal, proceed to the thoracic member, where they form a plexus in the following manner: the fifth cervical passes behind the other four pairs, crosses them in their course, and unites with them in its passage. It then turns round the scapula, which in this animal is articulated with the first dorsal vertebra. We shall return to the description of this nerve. The sixth cervical pair proceeds directly along the scapula on its internal surface: it is crossed posteriorly by the fifth, and towards the lower third of the scapula receives the seventh cervical pair. The seventh is slender, crossed by the fifth and the first dorsal pair, and united with the sixth, in the manner we have pointed out. The first dorsal pair partly joins the seventh cervical, almost at the point where it comes out of the vertebral canal; it is then sent to the muscles of the shoulder.

We shall now pursue each of the cords we have mentioned to their termination.

The large nerve produced by the fifth cervical pair, having arrived behind and near the true articulation of the scapula with the spine, divides into three branches; one, which is but a filament, appears to be distributed to the articular capsule; a second, which is very flat, and from the sides of which a vast number of lesser branches extend to the muscles of the skin, appears to take the place of the musculo-cutaneous; the third branch, which accompanies the muscles of the scapula under the skin, descends to the humerus, without producing any remarkable branches. At this place, however, it sends off several ramifications to the extensor muscles of the fore-arm. The trunk continues its direction forward, expands and loses itself under the skin, and may be followed as far as the hand: it may, perhaps, be regarded as supplying the place of the ulnar nerve.

The sixth pair of cervical nerves having, as we have shewn, assisted in forming the brachial plexus, passes along the internal surface of the scapula; about the lower third of that bone it receives the seventh pair; the nerve then becomes thicker, but soon after divides into two branches; one, which is slender, passes into the groove, between the furca and the clavicle, and then spreads over the articular capsule of the humerus, after furnishing numerous filaments to the muscles which surround it; the nerve may be regarded as analogous to the articular in man. The trunk of the nerve, which evidently supplies the place of the median, upon reaching the articulation of the humerus with the scapula, transmits filaments to the adjoining muscles. On arriving at the palmar surface of the fore-arm, it divides into three portions, two of which are on the ulnar side, and sink deeply into the muscles; the third, which is much larger, follows the radial side of the fore-arm, and at the base of the thumb proceeds to the palm of the hand, and detaches filaments to each of the fingers.

The seventh cervical pair unites, as we have stated, to the sixth, at the posterior part of the scapula, to form the median and articular nerves. We have, therefore, no occasion to return to its description. The first dorsal pair is lost in the muscles of the shoulder, and is not continued throughout the arm.

The brachial plexus of the lizard differs a little from that of the tortoise; it is formed by two dorsal, and the two last cervical pairs: the first of the cervical furnishes only one of its branches to the plexus; the other going to the neck.

In the frog, the nerves, which are to be distributed to the arm, proceed from a very thick cord, which comes from between the second and third vertebræ: this makes the largest nerve in the whole body; it is soon after joined by a filament from the succeeding pair, with which it intimately unites; this cord proceeds towards the axilla; it sends off a branch, which passes above the shoulder, and is lost in the muscles of that part. The trunk continues its course to the arm, and very soon forms two principal branches, and besides these, it also sends some filaments to the extensors of the fore-arm, and the articular capsule of the head of the humerus.

Of these two nervous cords, one is directed forward upon the humerus, and represents the median nerve; it detaches some filaments to the muscles of the skin. Arrived at the fold of the fore-arm, the nerve plunges amongst the muscles, along with the tendon of the sterno-radialis, which supplies the place of the biceps; it afterwards divides into two branches, placed one above the other: the most slender is situated between the flexor muscles of the fingers; the larger upon the furrow, which indicates the union of the two bones of the fore-arm; they pass under the ligaments of the carpus; having reached the palm, the superficial branch is lost in the skin, which covers that part, and the deep-seated is distributed to each of the fingers, nearly as in man. It also furnishes some filaments to the muscles of the hand.

The other cord represents the radial nerve; it turns round the humerus, and furnishes, in the first place, some branches to the extensor cubiti; continuing to descend round the humerus, it arrives before the articulation with the bone of the fore-arm: it is afterwards divided; one of the branches is lost under the skin, the other passes under the back of the hand, and terminates on the convexity of the fingers. From this description it will appear, that the nerves of the arm in frogs very much resemble those of the wing in birds.

In the salamander, the nerves of the arm are distributed as in the frog, but the brachial plexus is formed by two cervical, and two dorsal pairs, if we may regard as dorsal vertebræ, those which sustain rudiments of the ribs.

There are no brachial nerves in serpents.

Nerves of the hind Limbs.—In lizards, there is only a small nervous filament, which proceeds from the femoral nerve, and supplies the place of the obturator. The femoral nerve is itself formed of the two last lumbar pairs, and passes above the bones of the pelvis to be distributed in the muscles of the anterior part of the thigh. The sciatic nerve is produced by the three pairs of nerves, which follow, and which also receive a filament from the last lumbar pair; the only cord they form proceeds along the inside of the thigh, subdividing in the muscles, and extending to the toes.

The distribution of the nerves in the abdominal member is nearly the same in the salamander; there are no differences, except in the manner in which the plexus is formed. The femoral is produced by a single lumbar pair, which transmits a branch to the sciatic plexus, formed by the two succeeding pairs.

In the frog, three pairs of nerves enter into the composition of the femoral plexus, before which they run the whole length of the ossa ilii, which are very long: when arrived at the thigh, the plexus sends off a nerve, which corresponds to the anterior femoral; it is distributed in radiated filaments to the fore part of the thigh. The rest of the plexus proceeds into the pelvis, and forms a large cord, which passes to the posterior part of the thigh, and may be

regarded as the sciatic nerve. A great number of filaments are afterwards detached from it to the muscles: about the middle and posterior part it divides into two branches, which pass under the ham, and represent the two popliteal nerves, the external and internal: these are afterwards distributed to the foot of the posterior leg, nearly in the same manner as to the human foot.

Great Sympathetic Nerve.—There is no description of the distribution of this nerve in reptiles, except in the mud tortoise; in which animal it was dissected by Cuvier. It is only distinct in the interior of the back-shell; it has a disposition analogous to that of the cervical ganglion. The pneumo-gastric nerve, however, adheres so closely to it, that they cannot be separated: we did not perceive any filament on the neck, which could be regarded as the trunk of the nerve.

On the peritoneum, and on the bodies of the vertebræ, there appear very distinct nervous ganglia, which are manifestly produced by the great sympathetic.

The ganglia are exactly similar to those of birds. There are two superior and two inferior filaments, which pass under the transverse process of the vertebra, that is united to the back-shell: from the internal edge of each ganglion, a splanchnic nerve proceeds, which forms a plexus round each of the arteries produced by the aorta; one is also sent to assist in forming the pulmonary plexus.

This nerve may be very easily traced to the internal parts of the first vertebra of the tail.

Physiology of the Nervous System.—The obvious differences of structure between the warm-blooded animals and reptiles, in this system; the exceedingly small brain and large nerves of the latter, contrasted with the slender nerves and large encephalon of the former, lead us to expect no less striking differences in their economy, than those which we actually discover. Are we to explain by this difference the little influence that the brain exercises over the other functions, and the great individual and independent vitality, if we may use the expression, of the parts, which appear in so many instances in the amphibia? The severest injuries, which in man or the warm-blooded animals would excite a sympathetic disturbance of every function, highly dangerous, and in most cases fatal, are borne with little apparent suffering, and restored with facility. (See the facts adduced in the physiology of the circulating system, to prove the tenacity of life in this class.) Can we explain in the same way the reproductive powers of this class? Blumenbach seems to consider the explanation sufficient. "The extraordinary strength," says he, "of the reproductive power in several amphibia, and the astonishing facility with which the process is carried on, must be explained, if I mistake not, from the great magnitude of their nerves, and the diminutive proportion of their brain. The former parts are in consequence less dependent on the latter; hence the whole machine has less powers of motion and displays less sympathy: the mode of existence is more simple, and approaches more nearly to that of the vegetable world, than in the warm-blooded classes: but, on the contrary, the parts possess a greater individual independent vitality. Since, in consequence of this latter endowment, stimuli, which operate on one part, or one system, do not immediately affect the whole frame by sympathy, as in warm-blooded animals, we are enabled to explain the peculiar tenacity of life, which is displayed under various circumstances in this class; viz. frogs continue to jump about after their heart has been torn out; and tortoises have lived for months after the removal of the whole brain from the cranium. The long continued power of motion in parts

which have been cut off from the body, as in the tail of the water newt, and in fragments of the blindworm, may be explained upon the same principles." Handbuch der Naturgeschichte, ed. 6. § 98. p. 221.

The close connection between the brain, heart, and lungs in warm-blooded animals, in consequence of which the cessation of action in one very speedily stops the others, and consequently brings on general death, has been fully explained in various articles of this Dictionary; viz. DEATH, HEART, LUNGS, NERVOUS System.

Observations and experiments have not yet been sufficiently multiplied, to enable us to understand all the minutiae connected with this subject. But obvious phenomena, which we have already alluded to, shew us a vast difference in this respect between mammalia and reptiles. The interruption of respiration, which is fatal in two or three minutes in the human subject, does not stop the action of the heart and brain until after some hours in reptiles. The removal of the heart, or of all the blood from the circulating system, does not prevent the action of the brain, and thus prove fatal, until after some hours. And, lastly, the removal of the whole brain, or decapitation, which, by interrupting the action of the muscles employed in breathing, is almost suddenly fatal in warm-blooded animals, does not very greatly affect reptiles. At least, they only seem to die from inanition after the operation. Hence breathing cannot be under the immediate influence of the brain in these animals, for its interruption is fatal in a few hours. Le Gallois asserts that death follows much more quickly, when decapitation is effected below the occipital foramen, than above it, because in the latter case the part of the brain is left, which he has asserted to be necessary to respiration; viz. the origin of the eighth pair. (See his Expériences sur le Principe de la Vie, p. 42.) He does not, however, afford us the materials of drawing any accurate comparison, and he allows, that when decapitation is performed in the first vertebra of the neck, the animal survives the operation much longer than it can survive the interruption of respiration. He says, that salamanders live three or four months, and seem to die only from inanition, when decapitation has been performed above the foramen magnum.

To the small influence of the brain upon the nerves, Blumenbach is inclined to refer, in some degree, the low temperature of reptiles. Although he considers it now as certain, that the lungs are the source, and the oxygenous part of the atmosphere the material, whence the heat of living animals is derived, he ascribes to the action of the nervous system a considerable influence in exciting and supporting the evolution of animal heat. Specimen, p. 22.

The brain seems to exercise as complete and prompt a dominion over the voluntary muscles in these, as in warm-blooded animals. Their motions are equally lively, and the force of contraction does not seem at all inferior.

We know of very few facts that throw light on the intellectual faculties of reptiles. Yet there is sufficient evidence of their possessing memory and a capability of instruction. The frog and tree-frog can be taught to feed from the hand; and acquire a slight attachment to their master. (Daudin, v. 8. p. 88.) The rattlesnake, the hooded-snake (col. naia), the box, and the coluber natrix in Europe (at least commonly in Germany), are taught to dance, and exhibit various motions at command. (Kämpfer, Amœnitates Exoticæ, p. 565.) In the historical accounts of the religion of ancient Egypt, we learn that the priests of Memphis bred up crocodiles in their temples, and succeeded so far in depriving them of their ferocity, as to employ them in religious ceremonies. Besides the accounts of Herodotus,

Strabo, &c. on this subject, we have the authority of a respectable eye-witness concerning very surprising success in taming a crocodile; see J. Greaves's Miscellaneous Works, p. 525: and for the like success in the common toad, see Blumenbach, Specimen, &c. p. 27. We know not on what grounds the serpent gained his character for wisdom, intelligence, foresight; why he was selected as an emblem for the goddess of prudence, or chosen by the Epidaurians as the representative of Esculapius.

Of the artificial instincts, which are so frequent in the mammalia and birds, not even a trace is to be met with in the whole class of reptiles.

There is no regular sleep, or intermission of activity, in the organs of sensation and voluntary motion, recurring at stated intervals, in reptiles: unless, perhaps, in the turtles, of whom it has been reported by some.

Winter sleep, on the contrary, seems to prevail through the whole class. Herodotus observed this of the Nilotic crocodile, which, he says, passes four months of the winter without eating. Catesby has remarked it of the crocodile of Carolina; and Lacoudrenier reports, that those of Louisiana betake themselves to the muddy marshes when the cold comes on, and remain so torpid, that they may be cut without shewing signs of sensibility. But the warm days of winter re-animate them. Journal de Physique 1782, t. 20. p. 333.

No animals, except insects, are so sensible to heat as reptiles. The warmth of the sun seems to give them new life: as it increases, their vivacity and agility are augmented. Cold, on the contrary, benumbs them, and would be actually destructive, if they did not withdraw from its pernicious influence. They retire into the crevices of walls or rocks, the hollows of old trees, holes in the earth, or the bottoms of ponds, &c. to await the return of the genial season. The phenomena of this winter sleep are the same in reptiles, as in warm-blooded animals. The suspension of the actions of the nervous system is followed by an universal torpor of the other functions. As the brain and the organs of voluntary motion become inactive, the circulation languishes, respiration is barely continued, and vital temperature is reduced to the lowest degree.

Spallanzani found that when the temperature was reduced to $1\frac{1}{2}^{\circ}$ below zero, the heart of a serpent beat only twice in a minute, and respiration was suspended. (Rapports de l'air avec les êtres organisés, t. 1. p. 230.) In a temperature of 7° , the heart soon recovered its action, and beat ten or twelve times in a minute: in still higher temperatures, the pulsations were 28 or 30 per minute. (Ibid.) In the lethargic state, these animals changed the air very little. Frogs became equally lethargic in reduced temperatures; the heart beating very slowly, and the air being slightly changed. Ibid. p. 470.

Cold appears to be the immediate cause of this winter torpor; hence both reptiles and warm-blooded animals may be preserved in situations artificially warmed throughout the period of their winter sleep, without becoming torpid; but if the torpidity has commenced, they cannot be artificially awakened without danger. It is well known that the salamander, the water-newt, the tree-frog, and the alpine marmot, may be kept awake through the winter in a room warmed by a stove. Gleditsch witnessed the fatal effects of violent excitement in the winter sleep in the frog (Mem. de l'Acad. de Berlin, 1762, p. 17.): it has been observed also in the marmot, the dormouse, and the swallow.

It may be remarked further, of warm-blooded animals, as well as reptiles, that some species assemble together, and are gregarious in their torpidity, while others are solitary.

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The bat, swallow, frog, and salamander, exemplify the former.

Organs of the Senses.

Organ of Vision.—Reptiles, like all vertebral animals, have two moveable eyes occupying the cavities of the head called orbits, and possessing in their structure the same essential parts as in man. Their structure has not been much investigated: there is some information in a memoir of Petit, in the Acad. des Sciences, 1737; and an account of the tortoises in Caldesi.

They occupy the sides of the head, except in the crocodile, where they are placed above, between the cranium and jaw.

In the proteus they are covered by the integuments, and thus concealed until the latter are removed: this animal is, therefore, like the *zemu* or *mus typhlus* among mammalia, and consequently blind. All other reptiles have the sense of sight, and some possess even large and prominent eyes.

The tortoise has, at the anterior part of the sclerotica, similar ossæous laminae to those of birds. They are inclosed in that membrane, without being continued into its substance, and may be easily separated from it. There are similar laminae in theameleon and several other lizards, but they do not form the anterior disk, they merely surround the lateral part. Daudin has found this structure in the common iguana and the great *tupinambis* of America.

"In the tortoise," says Cuvier, "the ciliary processes project so very little, that we could scarcely recognize them, were it not for the elegant impression they leave on the vitreous body; but in the crocodile these processes are very beautiful, and very conspicuous: they are each terminated by a nearly right angle. I have observed these processes in the form of elongated threads in a large foreign tree-frog; there are also such, though not distinct, in the toad. I have not observed them in the common lizards, nor in the serpents.

"The iris of reptiles resembles that of fishes in its golden colours; sometimes it is red or brownish. The vessels are more visible than in fish; they form a beautiful net-work on the iris of the crocodile.

"The figure of the pupil varies; in the crocodile it is vertically oblong, as in the cat: in frogs rhomboidal. The tortoise,ameleon, and common lizards, have it round; the gecko rhomboidal.

"The optic nerve in all reptiles passes through the membranes of the eye directly, and by a round hole, as in quadrupeds; it forms internally a small tubercle, from the edges of which the retina proceeds.

"The crystalline is more spherical in the turtle and frog, than in the mammalia: the ratio of its axis to its diameter is in the former 7 to 9, in the latter 7 to 8: these proportions are nearly those which it has in fishes."

Muscles of the Globe.—There are six in the tortoise, disposed like those of fishes: and besides, four small ones, which closely embrace the optic nerve, and spread over the convex portion of the sclerotic, after being interrupted by the muscle of the third eye-lid. The same structure is found in the crocodile.

In frogs and toads there is a great funnel-like muscle, which embraces the optic nerve, and is divided into three portions; its inferior fibres advance more towards the edge of the eye than the superior. There is only a single straight muscle on the inferior part, and consequently only a single depressor. There is one very short oblique muscle attached to the anterior part of the orbit, and inserted directly into the adjoining part of the globe. The muscle of the third

eye-lid is so close to the inferior part of the suspensory muscle, that it becomes stretched when the latter swells; which accounts for the elevation of the third eye-lid when the eye is lowered.

Blumenbach remarks, that no instance of the leucæthiopic formation, or deficiency of the colouring matter of the choroid coat and iris, has ever been seen in reptiles; although it is so common in the two warm-blooded classes, and in the human subject. Specimen, p. 27.

Many reptiles shun the light, lying hid by day, and coming out to seek their food at night. Others appear very fond of light, whether that of the sun, as the green lizard and green frog; or of artificial flame, like that of a candle, as the tree-frog.

It seems peculiar to theameleon to have the power of moving the two eyes at the same time in different directions; so that he is not necessarily obliged, like other animals, to bring the two optic axes into the same direction.

Eye-lids.—Reptiles vary singularly with respect to the number and disposition of their eye-lids: serpents have none; crocodiles and tortoises have three, and the third is vertical, as in birds: there are also three in frogs, but the third is horizontal like the other two. The third eye-lid is the part called *membrana nictitans*.

The crocodiles are remarkable for having bone in the upper eye-lid: in general there is only a single bit near the anterior angle; but in the *crocodilus palpebrosus* the whole eye-lid is occupied by a plate divided into three pieces. See Cuvier in *Annales du Muséum*, v. 10.

The horizontal eye-lids of crocodiles and tortoises close exactly; they have each an enlargement at their edge, but no cilia; the third eye-lid is semi-transparent; it moves from behind forwards, and may cover the whole eye; it has only one muscle, which is analogous to the *pyramidalis* of birds: it is fixed in the same manner to the posterior part of the globe inferiorly. After having turned round the optic nerve, it repasses under the eye to send its tendon to that eye-lid; but there are neither the *musculus quadratus*, nor its sheath, as in birds.

In the other lizards there are also very remarkable varieties. The common lizards have, for eye-lids, a kind of circular veil extended before the orbit, and perforated by a horizontal fissure, which is capable of being closed by a sphincter muscle, and opened by a levator and depressor; its inferior part has a smooth round cartilaginous disk, as in birds; there is, besides, a small internal eye-lid, but it has no proper muscle; it is entirely wanting in theameleon, in which animal also the slit of the eye-lids is so small, that the pupil can scarcely be observed through it. The gecko has no moveable eye-lid; its eye is protected by a slight margin of the skin, as in serpents. A similar disposition seems to prevail in the scink.

Blumenbach has examined more particularly the structure of the part which covers the front of the eye in serpents. "These animals," he observes, "are commonly said to throw off the external layer of the cornea with the rest of their epidermis when they change their skin. On examining this matter more minutely in the *coluber natrix*, I find that that part of the epidermis, which is perfectly transparent and stretched before the eye, is not actually connected to the cornea, but separated from it by a small quantity of water. It is immovable, so that the globe moves behind it, as behind a window." Specimen, &c. p. 26.

In frogs and toads the superior eye-lid is only a projection of the skin, and almost immovable; the inferior is more moveable, and has a swollen edge; but the third, which moves from below upward, is most employed by these animals:

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mals: it is very transparent; it has one muscle situated transversely, behind the globe, which forms a thin tendon on each side of the eye, to be inserted into the free edge of the third eye-lid.

The salamanders have only two eye-lids, which are horizontal, fleshy, and little moveable; it appears that they may entirely cover the eye.

Reptiles vary as much with respect to their lachrymal glands as to their eye-lids.

The sea tortoises have a very considerable gland at the posterior angle; it is reddish, granulated, divided into lobes, and extends under the arch which covers the temple.

In the fresh-water tortoises we find two small blackish glands, which also exist in toads and frogs; but their excretory ducts have not yet been accurately observed.

Serpents, like fishes, have no gland in the eye; they have, however, a peculiar structure near the eye, the office of which is not very obvious; the following account of it is given by sir Everard Hume.

"An oval cavity is placed at the inner angle of the eye in some serpents, the opening into which is within the inner angle of the eye-lid, and directed towards the cornea. In this opening there are two rows of projections, which appear to form an orifice capable of dilatation and contraction. These cavities are lined with cuticle, which is shed with the rest of that integument. From the situation of these oval cavities, they must be considered as reservoirs for a fluid, which is occasionally to be spread over the cornea; and they may be filled by the falling of the dew, or the moisture shaken off from the grass, through which the snake passes." Phil. Trans. 1804, p. 75. with a figure.

Organ of Hearing.—Such an organ is possessed by all reptiles. Its construction varies considerably in the different orders and genera: these varieties affecting the external or accessory parts, as the tympanum, ossicula, &c. more than the essential portion of the organ, its membranous labyrinth, on which the auditory nerve is expanded. No reptile has any external ear; and the crocodile affords the only example of a kind of external meatus. Frogs, testudines, and most of the lizard kind, have a tympanum and Eustachian tube; but these parts are wanting in the salamander, and most of the serpents. The ear of the turtle, tortoise, frog, lizards, and serpents, are described and delineated by Brunelli in the Comment. Instit. Bonon. v. 7. Comparetti has exhibited figures of the same subjects in his *Observationes Anatomice de aure interna comparata*, Patav. 1789, 4to. Scarpa has given most beautiful engravings of the ear in the turtle, crocodile, green lizard, salamander, viper, and blind-worm, in his *Disquisitiones de Auditui et Olfactu*.

The Labyrinth.—The membranous labyrinth of the ear, in reptiles, is, in general, composed, as in fishes, of three canals and a sac; but there are some species which have an additional part.

In the salamanders, whose ear, like that of fishes, consists of the labyrinth only, the three canals are situated above the sac; they are depressed superiorly, and form together a triangle which is almost equilateral; each has its ampulla, and the sac contains a body of the consistence of starch, as in the rays and sharks.

Frogs and toads differ very little from salamanders, with respect to the membranous labyrinth; they have the same parts in the same position, and their sac also contains one amylaceous substance: their three canals form nearly a complete circle, by their junction with the sac.

Crocodiles and lizards have also three canals, but they are larger, and each approaches nearer to a perfect circular form: the sac is situated proportionally more within the

head; its membranous parietes are furnished with several blood-vessels, which are particularly conspicuous in the crocodile. The solid parts it contains are three in number, and they are smaller, and even softer, than those of the chondropterygious fishes. Lastly, their labyrinth is rendered remarkable by having an additional part to those we have already described: this is the first vestige of the cochlea; it is the production of the sac, in the form of a cone slightly arched; it is directed, under the cranium, towards the middle line, and is divided into compartments, or rather canals, by a double cartilaginous septum; one apartment communicates with the sac; the other, which is a continuation of the first, reflected on itself, terminates at a very small hole, which is closed by a membrane that separates it from the cavity of the tympanum.

This organ is precisely similar to that which is found in all birds. Comparetti was the first who described it in lizards. It is very large in the crocodile, and may be easily prepared from young subjects.

It is more difficult to find this in the camoleon and the marbled lizard. A vestige of it may be observed in the serpents. The production which may be compared to this trumpet, or rudiment of the cochlea in the tortoise, is very similar to the part we named the sac, strictly so called, in fishes; and this resemblance consists not only in its form, but in the small amylaceous substance it contains: this seems to leave no doubt of the analogy between the sac and the cochlea in man, or of that between the part we call the sinus, and the vestibule. We must, therefore, judge of the perfection of the labyrinths of these different ears, by the degree in which the cochlea is developed.

Tortoises and serpents have the semi-circular canals, like other reptiles. In the tortoise they are proportionally very short.

The *osseous labyrinth* of reptiles resembles that of the chondropterygii; that is to say, it envelops the whole of the membranous labyrinth, but in a manner more or less closely.

In the tortoise, the septum, which separates the vestibule from the cranium, is not ossified; it remains partly membranous. The membranous semi-circular canals are much smaller than the bony cavities containing them.

In the crocodile and other lizards, the osseous labyrinth closely embraces the membranous, or completely covers it by a thin and hard lamina.

Cavity of the Tympanum and its Appendages.—Among reptiles, the salamander has the labyrinth completely inclosed within the cranium, and deprived of all external communication, as in the fishes that have fixed branchiæ. But the other genera of the same order have all a fenestra, called *oval*, supporting an osseous plate, analogous to the bone called stapes in man. The lizard genus has another aperture, closed only by a membrane, and called *fenestra rotunda*.

The barrel, or cavity of the tympanum, cannot be said to exist in serpents: the stalk of the plate, filling the fenestra ovalis, is surrounded by the flesh, and its extremity touches the skin, near the articulation of the lower jaw.

In toads and frogs, the whole of its posterior part is membranous; it communicates immediately with the back of the mouth, by a large hole, which may be seen on opening the mouth of the animal. It is very small, and almost entirely membranous in the pipa, in which the labyrinth is connected with the fenestra ovalis by only a very long canal.

It is also membranous posteriorly and inferiorly in the common lizards, and in the camoleon: it communicates with the bottom of the palate by a short wide canal.

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The barrel of the crocodile may be divided into two parts: one external, which is very wide, and closed on the outside by the membrane of the tympanum, and the skin, but entirely surrounded by the bones; and one internal, which is separated from the former by a contraction, and which communicates with the two fenestrae, and with some cavities analogous to the mastoid cells of man, but much larger. One of these cavities is placed between the femi-circular canals, and the other is directed backward and outward. The barrel is situated towards the superior part of the cranium.

The cavity of the tympanum in the tortoise is placed more laterally: it is not so wide externally; and the contraction, which separates the external part from the internal, is less conspicuous, because the projection, which it forms, is rounded, and not acute, as in the crocodile. The internal portion is prolonged backward, in the form of a large round cell: in the bottom of the cavity, opposite to the membrane of the tympanum, there is a narrow canal, in which the ossiculum is sunk, and which communicates with the fenestra ovalis. The Eustachian tube is a canal of a moderate length, which proceeds downward, and a little backward, and terminates in the palate, behind and within the articulation of the jaw.

The Membrana Tympani and its osseous Frame.—Animals which want the barrel of the tympanum, as fishes, salamanders, &c. have no membrana tympani. That membrane is also wanting in several reptiles that have a barrel, as theameleon: the skin passes over the external aperture of their ear, without undergoing any change, either in its thickness or its structure; and the existence of the organ of hearing can only be ascertained by dissection. On removing the skin, and some portions of the muscles, we find, in some species, and particularly in the slow-worm (*anguis fragilis*), a kind of membranous expansion.

In the tortoise, the large external aperture of the barrel is closed by a very thick cartilaginous plate, which is itself covered by a scaly skin, perfectly similar to that of the rest of the head.

In frogs and toads, the membrana tympani is on a level with the head, and the skin that covers it becoming finer, it is rendered perceptible by an oval spot, which is smoother than the rest of the head, and usually of a particular colour.

In common lizards, the membrana tympani is also level with the head, but very thin, smooth, and transparent; for at that part the skin becomes as smooth and fine as the cornea of the eye.

In the crocodile, it is of the same nature, but more sunk into the head, and covered by two fleshy lips, which supply the place of the external ear.

In lizards, though the point of the cone formed by the membrana tympani projects less than in birds, it is also directed outward, as in them. The membrane is nearly plane in frogs and tortoises.

The membrana tympani is on a level with the adjacent parts of the head, and consequently is nearly vertical in all animals in which its situation is superficial; but in those which have it sunk, its inclination, whether considered with relation to the head itself, or to the external meatus, varies considerably.

It inclines obliquely upward, and to one side, in the crocodile.

The osseous frame, to which the membrane is attached, is not marked by any prominent edge: it is interrupted posteriorly. Its great axis is vertical in the tortoise and the common lizards, and its anterior arch is more convex.

In the crocodile, it is a regular oval, the great axis of which is directed obliquely backward.

Ossicula Auditus.—The frog and the toad have two ossicula in the ear: one supplies the place of the malleus and the incus; it is attached to the membrana tympani by a slender branch, which forms an acute angle with the part that passes into the barrel: that part has the shape of a club; its internal extremity is the thickest, and articulates by a double surface to the second ossiculum, which corresponds to the stapes. The latter has a semi-elliptic form, and is applied to the fenestra ovalis by its plane surface: both these bodies, which are ossiculi in other animals, are cartilaginous in the frog and toad.

Lizards and tortoises resemble birds, in having a single ossiculum with a thin hard stalk, and an oval or triangular plate (*columella*). It is attached to the membrane of the tympanum in lizards, and particularly in the crocodile, by a cartilaginous branch; but in the tortoise, its outward extremity is directly implanted in the cartilaginous mass, which corresponds to the membrana tympani itself.

In the crocodile, the plate is an elongated ellipsis, the great axis of which is situated longitudinally.

In the tortoise, the bone is enlarged in the form of a trumpet, and is applied to the fenestra by a regularly oval and concave surface.

Serpents have an ossiculum, but no membrana tympani. Its external extremity touches the bone that supports the lower jaw: it is surrounded by the flesh, and is applied to the fenestra by a concave plate, the edges of which are irregular.

In theameleon, the plate also represents the wide end of a trumpet; its stalk becomes cartilaginous, and is lost in the flesh.

The fenestra vestibularis of salamanders is closed only by a small cartilaginous operculum, which has no stalk, and is concealed by the flesh.

Muscles of the Ossicula.—Little is known about these in reptiles. It appears that serpents, camelions, and salamanders, are entirely destitute of them, and that they are very indistinct in the testudines. Comparetti has made some researches on this subject, but without any clear or satisfactory results.

External Meatus, &c.—All parts of the ear, external to the membrana tympani, are wanting in reptiles. In the crocodile only is there any appearance of an external meatus, the skin forming a kind of lip or operculum above the membrana tympani: the latter is entirely concealed, except when this covering is removed. This must be the part mentioned by Herodotus as the external ear of the crocodile, to which the Egyptians attached rings.

Distribution of the Nerves.—In reptiles and fishes, but especially in the latter, we can observe, still better than in warm-blooded animals, the constancy with which the branches of the auditory nerve proceed to the ampullæ of the semi-circular canals. In reptiles it divides before it passes into the osseous labyrinth, which it enters by several holes.

Organ of Touch and Integuments.—It does not seem clear that reptiles possess the sense of touch, that is, the power of recognising, by any parts of their skin, the figure, hardness or softness, roughness or smoothness, of bodies. To the impressions of heat and cold, there is no doubt of their being sensible.

In no class do we observe so much variety in the nature of the integuments; the skin is different in almost every species. In many the structure is so singular, that if we judged by this alone, we should form them into separate classes. What

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a contrast does the shell or bony case of the tortoise form to the smooth skin of the tree-frog; how different are the annulated skin of the amphibia, the scaly covering of other serpents, and the integuments of the toad, rough and tuberculated.

Epidermis.—When we examine what parts of the body are covered with skin in the tortoise and turtle, we can recognize it at first sight only on the head, neck, limbs, and tail; the other parts exhibit to us merely an ossous box or exterior skeleton, inclosing the body. But, if we examine more attentively, we shall find this skeleton covered by an extremely thin epidermis, which may be detached in transparent laminae, similar, in figure, to the horny plates, and varying in its consistence in the different species. It resembles a smooth and transparent parchment in the testudo centrata of Boisc (Daudin, t. ii. p. 153.) The epidermis covering other parts of these animals is a smooth thin layer, not essentially different from that of the frog and salamander, and detached in shreds several times in the year.

The epidermis of the salamander and frog is a soft thin membrane, covered with a mucous secretion; which answers a particular use in some kinds, as the rana calamita, enabled by its assistance to adhere to the smoothest bodies. This secretion, a simple and innocent mucus, is very different from another, which is found in many reptiles, possessing extremely powerful sensible properties; the latter is described under the head of peculiar secretions, in the latter part of this article.

The thin transparent cuticle of the frog, salamander, and newt, is very frequently changed, being detached in large portions. Blumenbach states that this change takes place in the summer months at least once a week. Specimen, p. 26.

The epidermis of lizards covers all their scales, and is detached in small dried portions, or in larger pieces. It forms also a thin continuous stratum in serpents, enveloping the whole surface, and spread over every scale and plate. It is detached annually, at a certain season, in a single piece, like a sheath. The cast skin (slough, exuviae) is turned inside out, so that its exterior surface is the part previously in contact with the true skin. The animal escapes at the mouth, which is the only opening by which it can get out of the sheath. The part corresponding to the jaws is first detached, and turned back, so as to expose to us the snout, covered by a new skin. As the head passes out of its sheath, the latter goes backwards in the same proportion towards the tail, and is thus at last completely inverted. The transparent piece corresponding to the eye (see an account of the eye) has its concavity outwards.

Rete Mucosum.—In all reptiles there is, under the epidermis, a mucous tissue, of which the colours vary very much. In the testudines, for instance, the skin which covers the feet and neck is not only differently coloured by the rete mucosum, but the symmetrical spots, which we remark on the scales, are produced by the same substance. This we discover by dissection. The thickness of the skin greatly diminishes as it approaches the breast-plate and the back-shell. It passes below the scales which cover those parts, and which are, themselves, covered by the epidermis and rete mucosum; the variegated colours of which form the spots which we observe through the transparent parts. A rete mucosum is equally found in the lizards, serpents, salamanders, frogs, &c. It is variously coloured in each species; and it presents often the most beautiful and charming tints. We find in this class almost all the known shades, even blue, bright red, orange, pearly, gold and silver.

Reptiles are remarkable for the changes of colour which they exhibit, according to the season or climate in which they live, or to temporary affections of various kinds. In this way theameleon has been most celebrated, and has afforded a very trite subject to poets and moralists. The changes are, in reality, very remarkable, and are particularly noticeable when the animal passes from the shade into the sun, or *vice versa*, when he is touched, or any thing placed round him, &c.

This property, however, is, by no means confined to theameleon. Brown long ago observed it in several species of lizards (Natural History of Jamaica, p. 462.); and it occurs also in reptiles of these climates. The green iguana, the agame, and the green lizard, are sometimes green, sometimes brownish in their colour. The former is particularly observed in the copulating season; and is lost in the cold and rainy parts of the year. The common tree-frog of Europe exhibits various tints from the brightest emerald green to grey, blueish, violet, or brown. Other frogs and salamanders change their colours also, particularly about the copulating season.

The Papillae.—Reptiles resemble birds with respect to the papillae; we find none except under their feet; they are very thick, and projecting in several species of lizards, and particularly in theameleon. We cannot distinguish them in the sea tortoise, which have the feet in the form of fins. They do not exist in serpents, or at least have not the form of papillae.

Cutis.—Reptiles which have the body unfurnished with scales, or only partly covered by them, have a very compact and dense skin. We have an example in the tortoises, salamanders, frogs, and toads. In the two last genera, in particular, the cutis is rendered remarkable by not adhering to the body in all its points, as in the other animals, in which it is intimately united with the cellular substance. In those genera, however, it adheres only at the edges of the mouth, in the middle line of the body, the arm-pits and the groins. In all the other parts the body is free within the cutis, which incloses it like a sac.

In lizards and serpents we find, as in fishes, a strong cutis under the scales, even adhering very closely to the muscles.

Cutaneous Muscles.—There is no cutaneous muscle on the trunk of frogs, because the skin does not adhere to that part of their body. Under the throat, however, we find some fibres, which are attached to the margin of the jaw, and inserted into the cellular substance that unites the skin to the origin of the breast.

In tortoises the cutaneous colli is very visible, and seems to be formed of two parts; it is extended from within the concavity of the lower jaw to the bottom of the neck, at the anterior part of the breast-plate. A middle cellular line unites it with the muscle of the other side; it takes its origin from the transverse processes of the cervical vertebrae. Being spread over all the muscles of the neck, it serves as a girdle to them; in its lower part it is perforated by the sternomastoideus, which, as we have already observed, arises from the lateral parts of the breast-plate.

Secretions of the Skin.—Among reptiles, those that have scales, as snakes and lizards, have the skin almost dry; but those with naked skins, as salamanders and frogs, have the surface of the body always copiously lubricated with viscous matter.

Toads and salamanders have even the power of augmenting the secretion of this liquor, and of making it exude, like a dew, through the pores of the skin.

The cutaneous glands are more visible in cold-blooded animals, than in the mammalia.

The salamanders have several glands ranged along the back, which form elevations or lumps on the skin.

The toads have them scattered irregularly on the whole surface of the body; we observe, in particular, two which are very large, behind their ears; these glands produce an acrid humour, which is a poison to very small animals.

In lizards, we observe a very regular row of small pores, which also yield a viscous humour.

Absorption of water by the skin of the frog.—Townson found that the frog, and tree-frog, when placed on a moistened paper, could absorb the moisture so rapidly, as nearly to double their weight in two hours, under certain circumstances. He states that they do not drink, but take in all their fluid in this way. (See his tracts and observations in natural history.) Daudin has verified the observation. He kept two frogs without any fluid for seven days, and then placed them in a bottle on moistened sheets of paper. In two hours they had nearly doubled their weight. Hist. Nat. des Reptiles, tom. i. p. 115.

Fingers.—The number of the fingers, and their flexibility, vary more in reptiles than in all the other classes.

Common lizards have, in general, five fingers, of different lengths, well calculated to embrace objects in every direction. Some, as the crocodiles, have them palmated, at least in the posterior feet. Others, as the gecko, have them invellid inferiorly with imbricated scales.

The camelion has them united by the skin, as far as the nails, in two parts, which form the forceps. The skin of their inferior surface is furnished with sensible papillæ. The long lizards, called seps and chalcides, have only three very small toes. The salamanders and frogs have them naked and destitute of nails. In tree-frogs, the extremity of the toes is enlarged into a spongy disk, capable of adhering with force to bodies. In tortoises, the toes are palmated. Lastly, the serpents are completely deprived of feet and toes.

The long separate toes of the batracian order, and of several lizards, seem well enough calculated to serve as organs of touch; they might be applied to objects, and would surround them in various ways. They seem, however, to be employed merely as instruments of motion.

“It has been said of serpents (observes Blumenbach), with more ingenuity than truth, that their whole body is a hand; by which they gain just notions of the tangible properties of bodies. There is much more foundation for stating that the sense of touch, which is here meant, does not exist in any of the amphibia.” *System of Comparative Anatomy*, p. 319.

Among the reptiles the scales vary greatly, according to the genera. In tortoises they are plates of a horny substance, which are very hard and dense in the greater number. But in the testudo coriacea, and several others, they are soft and flexible: sometimes these scales are imbricated, as in the hawk's-bill turtle; and then they are smooth, or channelled longitudinally; at other times they form compartments of different figures: in the latter case they are more or less convex, and surrounded with furrows, or concentric channels, in the midst of which are points, which are either scabrous, elevated, or blunt, as in the species named *geometrica*, *græca*, &c.

In the crocodile the scales are bony, arranged in transverse bands, and situated, in respect to each other, like the stones of a pavement. In the other lizards and serpents they consist of horny substance, and present almost every possible variety of form and arrangement.

Organ of Smelling.—This is less completely developed in the amphibia than in the two warm-blooded classes of vertebral animals. The sense of smelling is the most imperfect of the

senses in this class, says Daudin, if we may judge by the structure of the nostrils. Reptiles do not seem to employ their smell in discovering or selecting their food, or for any of the purposes to which the faculty is subservient in other animals.

We find, however, in the whole class, nasal cavities opening on the snout in front, and on the palate behind, lined with a vascular pituitary membrane, on which olfactory and nasal nerves are distributed.

There are also different projecting laminae within the nose; but they consist of folds of the internal membrane, and are not sustained by osseous parts. The tortoise has three laminae, which divide the nasal cavity into several fossæ. The middle one corresponds to the external aperture of the nostrils; between it and the next there is an oblique canal, which leads to the posterior nares. We find only some tubercles in frogs, and other small species. It does not appear that any researches have been made respecting the parts in the crocodiles.

The olfactory nerve differs in reptiles little from that of birds, as to its origin and course; it differs less in its distribution, since it also divides, according to Scarpa, upon the septum, and the membranous fold corresponding to the superior turbinated bone, without proceeding farther.

The *external nares* of reptiles, more or less approximated, and susceptible of contraction and dilatation, are usually furnished with only some fleshy strata, which dilate or contract their entrance. This is observable in the greater number of lizards, which differ from each other only as to the position of their external nares. They are closest to each other in the crocodiles. The *tupinambis*, the *stellions*, and the *camelions*, have them more removed, and situated more laterally. In the salamanders they are exceedingly small. In frogs we observe a small tube, the motion of which is very apparent, because it is extremely useful in respiration, as we have already shewn. The tortoises have also two very small approximated nostrils. In the *matamata*, and one or two other species, they are situated at the end of a short cartilaginous proboscis. The external nose is also rather elongated in some serpents; for example, in the *vipera ammodytes*, and the *coluber nasica*. In the rest of this order there are small lateral nares, capable of slight extension. In the rattlesnake, and some others, there is a small blind hole, near the nose, on each side; we have described it under the head of peculiar organs. See Scarpa de *Auditu et Olfactu*, for a description and figures of the nose in the turtle and viper.

The Organ of Taste.—All reptiles possess a tongue, but whether they have the sense of taste is not so clear. As they all swallow their prey whole, there seems to be little room for the exercise of taste. We have already spoken of the tongue, in the account of the salivary glands; and have entered further into a consideration of its mechanism and moving powers in our description of the organs of mastication and deglutition.

Substance of the Tongue.—Reptiles vary greatly with respect to the tongue, as well as in many other circumstances. The tongue of toads and frogs is entirely fleshy, attached to the lower jaw, and, in a state of repose, inflected in the mouth.

In salamanders, it is attached as far as the point, which is not moveable, and the whole tongue is only free on its lateral parts. Crocodiles have it attached to the lower jaw, both by the edges and the point; and authors long supposed that this animal had no tongue. It is entirely fleshy in both these genera.

The *stellions* and the *iguanas* have a fleshy tongue, which possesses nearly the same mobility as that of the mammalia.

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The scinks and geckos differ only in having the tongue notched at the extremity ; and in that respect it resembles the tongue of the slow-worms, to which, in general, the scinks are very much allied.

In common lizards, the *tupinambis*, or monitor, &c. the tongue is singularly extensile ; it terminates in two long flexible points, though semi-cartilaginous ; it completely resembles that of serpents, if we except the slow-worms and the *amphibæna*, which cannot elongate their tongue, but which have it flat, and only forked at the extremity.

The *cameleon* has a cylindrical tongue, which may be considerably elongated by a mechanism analogous to that which takes place in wood-peckers.

Structure of its Surface.—The tongue of the *tortoise* is furnished superiorly with long, soft, close, conic papillæ, which give it the appearance of velvet.

In the *crocodile* they are very short, and represent rather slight rugæ than papillæ. They form, on the contrary, a very distinctly villous surface in the *iguanas* and the *stellions*. The tongue of the *cameleon* is furnished with deep, close, and very regular transverse rugæ ; in the lizards, with extensile and forked tongues ; and in the serpents, that organ is singularly smooth, and as it were horny towards its points.

The *falamanders* have, like the *iguanas*, a fine villous surface to the tongue ; but in the frogs and toads the surface is perfectly smooth to the eye, and always mucous.

No reptile has two kinds of papillæ, nor glands with a calyx.

Peculiar Organs and Secretions.—Many *amphibia* produce singular and specific odours, particularly when irritated. In the water newts the smell has been compared to that of chopped parsley ; in toads to garlic ; in the *crocodile* there is a very strong smell of musk ; and several *tortoises* have this musk-like smell. A singularly fetid odour is produced by the *rattlesnake*, when angry. May we suppose that this is a defence against hostile attacks, in the *falamanders* and water newts, as it seems to be in the *viverræ*, and some frogs ?

It may probably serve in spring, as *Blumenbach* suggests, as a means of venereal excitement. For if, after handling female toads for some time, the hand is plunged into water, where there are male toads, they flock instantly to the spot, and closely embrace the fingers. Specimen, p. 20.

The notion that this odour is employed by the *rattlesnake* to suffocate, fascinate, or in any way whatsoever to act on the animals which form its prey, is entirely ungrounded, as we have already explained.

There are generally manifest organs for the secretion of the substances in which these properties reside. Small granulated tubercles are seen under the thighs of the lizards, the *chalcides*, and the *marbled iguana* of Surinam, and near the anus of the *amphibæna*, producing, particularly in the coupling season, a fluid, and smelling like dry hay.

Musk Gland of the Crocodile.—It lies under the skin of the lower jaw, on each side, about its middle. It is a small gland, of a homogeneous whitish tissue, and covered by a tendinous sheath. It secretes an unctuous blackish-grey fluid, smelling most strongly of musk, and collected in a small bag, which opens externally by a large orifice.

Anal Glands have also been observed in the *crocodile* and *alligator*, as well as in several serpents. They may be seen of considerable size in female colubres, under the tail behind the cloaca, in the part occupied by the penes of the males. They contain a thin yellow substance. Tyfon has described them in the *rattlesnake*. Other snakes have been described as producing powerfully fetid odours from the mouth.

Poisonous and Acid Secretions.—There is a striking difference in this respect between warm-blooded animals and reptiles : none of the former produce any thing poisonous, unless we should make an exception concerning the liver of the *urus arctos*, which is described by Ger. de Veer, one of the unfortunate sufferers, to have been nearly fatal when employed as food by Heemskerck and his companions, compelled to winter in Nova Zembla. *Blumenbach's Specimen*, p. 30.

Besides the terrible poison with which so many serpents are armed, already described in our account of the teeth, there are several more or less actively hurtful secretions in this class.

The glands or crypts under the skin, forming the cutaneous eminences in the *falamander* and toad, produce an irritating fluid, which they seem to have the power of excreting at pleasure. *Blumenbach* describes the acrimony of this fluid in the *rana bombina*, from his own experience of its effects. Having cut his hand while handling some of these animals, and applied it to his mouth to suck the wound, he found a caustic heat suddenly pervade the tongue and fauces, like what is produced by chewing the bark of the laurel ; and it continued for several hours. P. 24.

It seems to be an analogous fluid in the *falamander*, by means of which this most innocent little animal, so unjustly deemed venomous, can extinguish a few coals when placed in them. But the contortions of the body sufficiently attest the pain produced by this cruel experiment, which is soon fatal, if prolonged. The fabulous notion of the ancients, that this little reptile can live in fire, is well known ; and *Benvenuto Cellini* has ventured to assert the truth of it, on the faith of his own experiments. See his Life.

The notion of the *falamander* being able to live in fire is the more extraordinary, when we contrast it with the fact, that it has been found in cakes of ice, and after remaining frozen for some days, recovered. So that it can actually survive congelation.

Dr. Barton of Philadelphia has named an aquatic *falamander*, which he found near that city, *falamandra venenosa*, from the nature of the fluid which exudes from the tubercles of its back. *Daudin*, tom. viii. p. 229.

The *gecko* of Egypt produces a poisonous fluid of considerable activity. “ It exudes (says *Hasselquist*) from the lobules of the toes ; the *gecko* seeks for places and objects impregnated with marine salt, and passing several times over them, leaves its venom behind. I saw in 1750, two women and a girl, who nearly died in Cairo from eating cheese which had been thus poisoned. I had another opportunity of noticing the acrimony of this fluid, in the production of red, inflamed, and itching pustules on the hand of a man, who endeavoured to catch the animal.” The French naturalists, attached to the Egyptian expedition, confirm the report of *Hasselquist*. *Daudin*, tom. iv. p. 110, 111.

Rattle of the Genus Crotalus.—This singular organ consists of many pieces, from one to thirty, or more, perfectly similar, not only in form, but often also in size, composed of a brittle, semi-transparent, horny substance, similar to that of scales. The piece immediately connected to the body forms a small sheath, moulded on the last vertebra of the tail, which it incloses, and from which it is separated only by a thin membrane. Its surface presents three circular risings, corresponding to three elevations of the vertebra : the first, or nearest to the animal's tail, is the largest, and the two others decrease successively. All the pieces are encased one in the other, the posterior two-thirds of each being enveloped by the following. Of the three risings or rings on each piece, the anterior only is visible, the two posterior

terior being concealed by the following piece. The last, or extreme portion, has all its three rings visible; and the organ consists, externally, of this piece, and the first rings of all the others. The two last rings of each piece, included in the two first of the succeeding, retain it in its place; but, as the diameter of the former is less than that of the latter, each piece is quite loose, and plays freely about that which it envelops. None, except the first, is united to the skin of the animal, or connected by any muscle, nerve, or vessel; it is, therefore, merely an exterior covering, moved, as any foreign body would be, when the end of the tail is agitated.

The different pieces of the organ are formed successively on the skin of the tail, receiving from it the materials necessary for its development, and adhering to it until its growth is complete. A second piece, entirely similar to the first, is formed under it, and detaches it from the end of the tail. It is pushed backwards, leaving between its edge and the skin of the tail an interval occupied by the first ring of the new piece, of which the second and third rings are covered by the first piece. The latter is retained by this connection, but plays freely round the first piece. A third piece is formed under the second, as that was under the first; pushing the second backwards, but retaining it by its two posterior rings being included in the cavity of the second piece.

If the vertebræ of the tail continue of uniform diameter, all the pieces will be of the same size, and the rattle, consequently, is of one breadth throughout. On the contrary, if the vertebræ grow while the rattle is being formed, the pieces increase in size, and thus the rattle tapers to its end.

It is evident, from the preceding description, that one piece only can be formed at each partial moulting of the end of the tail; but as we do not know whether these moultings coincide with the general separation of the epidermis from the body, nor the periods of their recurrence, the number of pieces not only affords no proof of specific differences, but also indicates nothing about the age of the animal. Lacépède, *Hist. Nat. des Serpens*, 12mo. t. 2. p. 217.

Horns, &c. of other Serpents and Reptiles.—The Egyptian cerialles is so named, from its two moveable, pyramidal, four-sided, curved horns, about two lines in length, placed above the eyes. They consist of successive strata, of which the exterior separates like an epidermis, exhibiting always four grooved sides. The exterior stratum separates thus with the animal's skin, like the epidermis of the scales, which this resembles entirely in its texture. Lacépède, *ubi supra*, t. 1. p. 256.

In the batracian order, the horned frog has a conical horny elevation above each eye; and the rana margaritifera a peculiar hard crista on each side of the head.

The cecilia ibiara has two small tentacula or cirri, scarcely visible near the nostrils; and the serpent, which Lacépède has named *erpeton tentaculé* (*Annales du Muséum*, t. 2. p. 280.) has two fleshy appendages, covered with scales, extending from the end of the snout horizontally forwards. Is there any probability that these parts in the cecilia and *erpeton* are organs of touch?

Facial Pouches of Serpents.—A small bag has been observed in the rattlesnake, in sixteen colubres, and three box, between the eye and the nostril; it has a rounded form, resting in a hollow of the bone, in shape not unlike the orbit. A small orifice behind the nostril leads to it. These bags, which are lined with cuticle, have their covering cast with the rest of the animal's skin. The cavities in question

were noticed in the rattlesnake by Tylon, *Phil. Trans.* v. 13. p. 26; and they have been since described and delineated by Dr. Russell and Sir Everard Home. (*Phil. Trans.* 1804, p. 70.) The latter anatomist discovered nothing like a secretory apparatus about them, nor any thing that could lead to conjectures concerning their office. They appear most analogous, in situation and structure, to the small bags of the deer and antelope, called by the French *larmiers*.

We conclude our review of the structure and physiology of reptiles with the summary of the principal differences between their economy and that of the warm-blooded classes, which terminates the excellent "Specimen" of Blumenbach.

"Et calidis quidem animalibus a prima inde formationis origine ad ultimum usque vite halitum phlogisticus ut hodie audit processus. Mammalium fœtui placentæ adminiculo, quæ fœtale phlogiston materno elemento igneo commutat. Pullo incubato porosæ testæ et albuminis ope, quæ itidem igneo pabulo aditum, phlogisto vero superfluo exitum concedunt. In lucem vero editis tum mammalibus tum avibus, perpetuo et alterno respirationis rhythmus.

"Internus porro huic phlogistico processui cum reliquis functionibus nexu, maxime cum iis systematis nervosi, ut hiberni mammalium veterani, phænomenis quæ supra tetigimus, verisimillimus redditur.

"Ipsi porro nervosi systematis summa cum reliquis functionibus conspiratio, præsertim ope reactionis sensorii ab ea encephali portione pendente, quæ præter originis nervorum super est.

"Ex his omnibus summus quidem functionum vigor, mobilitas summa, hinc corpus vivum infinitis modis innumerorum, et multifariorum stimulorum impetui et impressionibus suscipiendis aptum: hinc præ ceteris omnibus summa hominis prerogativa, in quo, uti, pridem observante Hippocrate, confusio una, conspiratio una, consentientia omnia, ita et omnium maximus et innumerus cum universa reliqua cum ambiente creatione nexus.

"Longe alia e contrario amphibiorum natura.

"Phlogisticus processus nostratibus perexiguus lentissimus.

"Debilis etiam in omnibus amphibis sanguinis in encephali functiones influxus.

"Exigua porro parvi sensorii in crassas nervas reactio.

"Minor hinc in universum consensus; minus unius functionis in alteram imperium.

"Minor hinc totius machinæ animatæ mobilitas.

"Verum eo major ab altera parte simplicioris istius vite tenacitas, quod parte una affecta, syllemate uno afflicto, non tam facile reliqua in consensum trahantur.

"In universum ergo vita magis vegetativa, reproductioni—ut per utrumque organicum naturæ regnum constat—longe magis opportuna, quam quæ altioris ordinis facultatibus, consensus, et complicatæ conspirationis subtilitate viget." P. 36.

Anatomical Description of the Proteus Anguinus, and Siren Lacertina.—See Cuvier, *Récherches sur quelques Reptiles douteux*, inserted in Humboldt's *Recueil d'Observations de Zoologie et d'Anatomie comparée faites dans son Voyage*, t. 1.

By the word *amphibious*, applied to animals, naturalists have meant to designate the power of living, and particularly of breathing, equally well in water and in air. In this sense it cannot be applied, with propriety, to any of the animals who have received the appellation from the ancients, and most modern naturalists. Without speaking of the otters and hippopotami, which are true aerial quadrupeds, visiting the water merely in search of food, the seals and cetaceous

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animals, compelled by their organs of motion to pass the whole, or nearly the whole of their life in water, can absolutely breathe air only.

All the reptiles to whom Linnæus subsequently transferred this name of amphibious animals, are similarly circumstanced in their adult state; they can only breathe air, whether they live constantly in this element, as the lizard kind, or betake themselves, for a longer or shorter period, to the water, as the frogs and salamanders. On the other hand, the cartilaginous fishes, which this same naturalist had joined to the reptiles, like all other fishes, can only breathe by the intervention of water; they have only gills; and it is by having represented as lungs the forked swimming bladder of some of them, that Dr. Garden caused the mistake of Linnæus.

The larvæ or tadpoles of the batracian reptiles only, that is to say, of the salamanders and frogs, the tree-frogs and toads, have both branchiæ and lungs; breathe, at least for a certain time, both the air in its elastic state, and that which is contained in water; consequently participate equally the nature of aerial and aquatic animals; and may, therefore, without impropriety, bear the name of *amphibious* in its most strict acceptation. But with these it is only a transitory, and with some perhaps only a momentary state. As their lungs are developed, their branchiæ are obliterated, and they entirely lose the latter, often even before reaching their full size, and particularly before they are capable of reproduction. Such, at least, is the result of observations on all the tadpoles of these climates, on all which it is possible to follow in their various developements.

But naturalists have observed three other animals, uniting, like our tadpoles, the two kinds of respiratory organs, not appearing to lose any of them at any epocha of their lives, and of such form and size, that it is said in the countries which they inhabit, no perfect reptile is known, of which they could be the larvæ. Are these creatures perfect animals—true permanent amphibia? Should they be considered an intermediate class between reptiles and fishes? We proceed to examine this question, observing, in the first place, that the structure of the circulating organs in the common tadpoles, which has been described in a former part of this article, must be kept in view as a point of comparison.

Anatomy of the Siren Lacertina.—This animal is common in the rivers and marshes of South Carolina, and is remarkable for possessing only the fore feet. Dr. Garden sent an individual to Linnæus, accompanied with a description, in which he mentioned the simultaneous existence of branchiæ and lungs, and declared that there is no salamander in Carolina large enough to have been produced from the siren. Hence Linnæus determined to establish for it a particular order of reptiles, the amphibia meantes. Nearly at the same time it was described in the Philosophical Transactions by Ellis, whose description was accompanied with an anatomy of the animal by Mr. J. Hunter. Yet several naturalists contested the result of these examinations. Pallas, Hermann, Schneider, and others, considered that it might be a larva. Camper, on the faith of an imperfect specimen, in which no lung could be found, concluded it was a fish, (*Kleine Schriften*, tom. iii. pl. 1. p. 20.); and Gmelin, on his authority, classed it among the eels.

Cuvier has had an opportunity of dissecting and describing it. His account, which settles the disputes satisfactorily, is contained in the *Recherches* already quoted, and has furnished the materials of the following description. The facts are represented in the 11th and 13th plates of the first volume of Humboldt's *Recueil d'Observations de Zoologie et d'Anatomie comparée*. The length was half a metre,

but it reaches sometimes between 30 and 40 inches. The body is much like that of an eel. The anus is at 15 centimetres from the posterior extremity. The head is not separated from the body by a neck: it is rounded, and terminated by an obtuse snout. The mouth is small, and the lips, which are not considerable, are not supported by any bones, as they sometimes are in fishes. The nostrils are two small holes near the edge of the upper lip. The eyes are placed above the angle of the mouth: they are round, small, without eye-lids, and only visible because the skin, in passing over them, becomes transparent. You may skin the head, like that of an eel, without injuring the eye-ball.

The openings of the gills are three vertical slits placed in succession behind the head: through them the water from the mouth is discharged. But there are no gills within, as in the lamprey for example; although Garden, Ellis, and Camper supposed it. The only branchiæ are three tufts or fingers, attached to the superior angle of the slits, to which Ellis and Garden gave the name of opercula, but of which Linnæus recognized the true nature. There are surely only three on each side, of which the first is the smallest, and the third the largest. The different statements concerning their number, which embarrassed M. Schneider, arise from the name having been given to different parts. For example, Linnæus, who rightly deemed the tufts to be branchiæ, reckons three, without opercula (*branchia ad latera colli utrinque tria, exserta*); but Garden, who conceived that the branchiæ were connected to the arches, says there are four, with three opercula, or one operculum of three lobes.

Each of the tufts consists of a large fleshy and conical pedicle, of which the inferior edge is divided into two rows of appendices, which are themselves again twice divided in the same manner. The animal must have the power of moving these branchiæ in every direction: the net-work of branchial vessels is expanded on their ramifications.

The fore feet, short and slender, are placed a little behind the branchial apertures. There are four fingers, of which the last phalanges are pointed, but not furnished with nails. There is not the smallest appearance of scales on the skin.

Osteology.—Although the individual examined by Cuvier had not reached its full size, ossification was considerably advanced. The cranium, lower jaw, and spine, were perfectly ossified. On the large bones of the arms there were epiphyses, and the scapula was almost entirely cartilaginous. The latter bone remains constantly in this state in the salamanders. The branchial arches were entirely cartilaginous, and probably continue so, as no point of ossification could be observed, although the os hyoides and its branches were already almost completely hardened.

From the head to the end of the tail there are ninety vertebrae: the anus is opposite to the forty-fifth, yet it is far from being opposite to the middle of the body, because the vertebrae of the tail, particularly towards its end, are much smaller than the others. The land salamander has thirty-eight, and the aquatic about forty. The pelvis is suspended opposite to the fifteenth or sixteenth, in the former; to the fourteenth or fifteenth, in the latter. There is not the smallest vestige of pelvis or hind leg in the siren: there is not even any germ of these parts, although they exist in the tadpole at all ages. It is, therefore, very certainly never destined to have hind legs. There is a kind of imperfect pelvis, even in the ophisaureus (*anguis ventralis*, glass-snake), a true serpent, though analogous to the lizards in some points, but never possessing hind legs.

Eight vertebrae only of the siren, from the second to the ninth,

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ninth, support small ribs, or rather very short false ribs. In the land salamander there are twelve or thirteen, and in the aquatic eleven. These small ribs, lost among the muscles, are only observed in the genus of serpents called cæcilia, where they exist in great number.

The individual vertebræ are very differently shaped from those of salamanders, frogs, and cæcilia. The body is terminated before and behind by a hollow cone filled with cartilage, which unites it to the adjoining bones, as in fishes. There is a small longitudinal prominence below; and above, a crista holding the place of the spinous process, and bifurcated behind. The four angles of the superior surface are occupied by the articular apophyses, of which the anterior have their articular faces turned upwards, and the posterior downwards. The transverse processes are formed of two triangular plates: one, inferior and horizontal, comes off from the whole side of the body of the vertebræ; the other flants backwards, and reaches from the anterior articular process to the posterior edge of the preceding. At the extreme point of their union we find the surface to which the rudiment of rib is articulated, in those vertebræ which have ribs.

None of the allied genera resemble the firen in the form of the vertebræ; and their singular shape would alone be sufficient to authorise us in constituting a separate genus for this animal. The head leads equally to the same conclusion, being entirely different from that of the salamander, and other reptiles. The nostrils, simply excavated at the sides of the snout, do not penetrate into the mouth: neither the orbit nor the temporal fossa is closed below. Hence the upper jaw-bone does not form a complete bony circle; its anterior part only is formed by the intermaxillary bones, and has no teeth. Thus the firen has only palatine teeth attached to the two plates, and not implanted in the palate. The prominence, having the surface for the articulation of the lower jaw, is much shorter than in the salamander. The lower is articulated with it by a convex surface, shaped like the segment of a sphere: its coronoid process is very short; each of its branches is composed of three pieces at least. The teeth are attached to their internal surface, and not implanted in their edges. The head is articulated to the neck by means of two condyles.

The bony apparatus of the branchiæ resembles that of fishes, with a few slight differences. A longitudinal bony piece bears, at each of its extremities, a pair of transverse portions. Each of these anterior portions is joined to a cartilage, which ascends behind the head, suspended by a strong ligament to the sides of the occiput: it is analogous to the piece which supports the radii of the branchiolegale membrane in fishes. But here there are no radii; and there is even a solution of continuity between this piece and the first arch of the branchiæ. This first arch, the largest of all, is joined to the posterior transverse piece mentioned above. The three others are joined to a third bony piece, similar to the preceding, but suspended behind it, and not articulated to the longitudinal piece. These four arches are simply cartilaginous. Their superior extremity is suspended to the second rib by a ligament, but not articulated to it. Their edges exhibit a series of small fine denticuli, which border the three branchial apertures: the anterior edge of the first arch, and the posterior of the last, not concurring in the formation of any opening, have none of these denticuli. The skin is immediately attached to these arches, and they support nothing, as we have already stated, analogous to the branchiæ of fishes. The tufts, which have no bone in their interior, are the only branchiæ.

The osteology of the legs is the same as in the sala-

mander: it comprises a slender scapula, terminated above by a cartilaginous dilatation; a large cartilaginous plate, which may be regarded as a double clavicle, analogous to that of the frog, the use of which is to protect the front of the chest; a humerus; two bones of the fore-arm; a carpus, of which the bones were too small and soft to be reckoned; a metacarpus and phalanges.

Organs of Sense.—The ear is the only one which Cuvier could observe accurately; it seemed to resemble that of the salamander. In the outer side of the bone inclosing the labyrinth, is an oval aperture, simply closed by a cartilaginous plate, covered by soft parts.

Organs of Circulation and Respiration.—There is a single auricle of considerable size, with its circumference denticulated, receiving all the blood of the body, and the lung; two large valves are placed at the mouth of the vena cava. This auricle communicates with the ventricle by a single orifice; and the blood departs from the latter by the aorta only. The heart is therefore exactly the same as that of the frog, the salamander, and of fishes.

The trunk of the aorta, or rather of the vessel, which in fishes is called the branchial artery, is furnished with fleshy and thick sides, and its basis has three strong valves. It divides into three branches on each side for the three branchial tufts, and no branch goes from it to any other part. These arterial branches become attached to the three cartilaginous arches in their way to the branchiæ; but they form no plexus on them, which proves that branchiæ are not attached to these arches as in fishes, and as Garden, Ellis, and Camper imagined in the firen.

Arriving at the branchial tufts, the arteries ramify over all their subdivisions, and the veins bring back the blood in a contrary direction. The same circumstances may be seen in the branchiæ of young aquatic salamanders, in which perhaps the circulation of the blood can be more easily observed with the microscope, than in any other animal organ.

Having quitted the tufts, the branchial veins assume the texture of arteries, and join together, towards the spine, to form the descending aorta; but they produce, before their union, the branches which in other animals arise from the ascending aorta, that is, those of the head, arms, and lungs: the latter come from the third of these branchial veins converted into arteries.

The lungs are two long cylindrical bags, extending to the posterior end of the abdomen, and then bent forwards. The veins and arteries form a loose network on their membrane. Air enters them through a larynx placed on the os hyoides, and opening between two small rounded margins placed vertically. A very slight cartilaginous prominence is observable on each side in its interior, and the glottis is between these: but there is no chorda vocalis with a sharp edge. Yet it does not follow that the observers, who have ascribed a voice to the firen, are inexact; for the approximation of the two prominences just mentioned would be sufficient for its production.

The trachea is a simple membranous, white, and thick canal, without any perceivable cartilaginous rings.

Organs of Digestion.—We have already mentioned the jaws and teeth. The tongue is not fleshy, nor very moveable: it is supported, as in fishes, by the anterior extremity of the os hyoides. It does not resemble that of the salamander, and much less that of the frog, both of which are more free behind than in front, and have a very glandular surface.

The œsophagus is folded longitudinally. The coats of the stomach are moderately thick; it first swells a little, then

then becomes muscular and contracted, and is narrower than the duodenum. The latter is the widest part of the intestine, which becomes smaller towards the anus. Although longer than the abdominal canal, and consequently forming several slight turns, it exhibits no great folds. There is no cæcum, nor any remarkable change of structure to point out the distinctions of different kinds of intestine. The pylorus has no valve; the mucous membrane of the stomach is smooth; that of the intestine has papillæ like small scales.

The canal is supported by two parallel mesenteries, of which the right adheres to the whole length of the liver. There is no omentum.

The liver is black, elongated, and occupies more than three-fourths of the length of the abdomen. The gall-bladder is lodged in a deep groove towards its middle, and furnishes a single canal, opening into the intestine a little beyond the pylorus. No duct could be perceived coming directly from the liver, but such a one might have been confounded with the numerous mesenteric vessels.

A slender and very long spleen is attached to the mesentery of the left side, and occupies more than three-fourths of the length of the abdomen.

Organs of Generation.—The individual examined by Cuvier was a female. The ovaries were considerably developed, about one-fourth of the length of the abdomen, oblong, composed of lobes, filled with very visible ova, although so flaccid that they probably did not approach to the size which they would have reached in the season of reproduction. A short and straight oviduct was closely connected to the kidney: this part was very different from the long tortuous tubes of the frog and salamander, and approached to the structure of fishes.

Organs of Secretion.—The kidneys were small, well supplied with blood-vessels, and situated at the sides of the rectum. The bladder elongated, and not divided as in frogs.

The conclusions drawn by Cuvier from the preceding account are; 1. That the firen, into whatever state it may pass, is a distinct animal, different in all the details of its organisation from the salamanders and their larvæ which we are acquainted with.

2. That it is very certainly not destined to possess hind feet, and consequently is a biped reptile.

3. There is no reason to suppose that it ever loses its branchiæ, since it is found to possess them at the largest size to which we know of its reaching, and the unanimous testimony of those, who have seen the animal in its native country, proves that no individual has ever been seen without them.

4. That it is essentially different from fishes in its osteological structure, and even in the organisation of the branchiæ.

5. That it therefore constitutes a particular genus of batracian reptiles, preserving always the double respiratory organs; and may be considered as a permanent larva of that family.

Anatomy of the Proteus Anguinus.—This animal was first noticed in the Synopsis Reptilium of Laurenti, in 1768. Scopoli gave a more minute account of it in 1772, in his Annus quintus Hillor. Nat. p. 75. Naturalists were divided in opinion, whether it should be regarded as a perfect animal, or only as the larva of some reptile. An excellent description of it, both as to its external characters and structure, was published in the Philosophical Transactions for 1801, pt. 2, by Dr. Schreibers of Vienna, in a paper entitled "An historical and anatomical Description of a doubt-

ful amphibious Animal of Germany, called by Laurenti Proteus Anguinus." Cuvier has since described it in his Recherches sur quelques Reptiles douteux.

The individual examined by Cuvier was 0.25 of a metre in length, and of the size of the little finger: Mr. Schreibers saw one of 0.33, or 13 English inches. The body is slightly compressed, and grooved at the sides, like the firen. The tail is more flattened, and furnished at its edges and end with a fin, which does not reach either above or below farther than the anus. The feet are slender; the knee and elbow being about their middle, and directed as in the salamanders; the fore-feet are terminated by three equal toes without nails, the hind-feet by two only; a combination, which is hitherto unique in the animal kingdom.

The head has some resemblance to that of an eel; the opening of the mouth is of moderate size, and furnished with thin lips. The nostrils are a longitudinal slit on each side, parallel to the side of the upper lip. No eye is perceptible externally; but when the animal is skinned, it is seen under the integuments as a black point, about the thirtieth of a line in breadth.

In the depression produced by the muscles at the sides of the cranium are seen the openings of the branchiæ. They are three, covered in some degree by a prominence of the skin, supported by a muscular stratum. The branchiæ are three small appendages, of a red-blood colour in the living animal.

The skin is whitish, soft, smooth, and presents some small prominences, when examined with a magnifying glass.

Osteology.—When the muscles, that swell the cranium externally, are removed, it appears flat, and quite on a level with the face; the latter terminates in a point in front. The middle of the cranium has its sides parallel; the posterior part swells out in the situation of the prominences to which the lower jaw is articulated, which are directed forwards. Behind, the occiput has two lateral cristæ for the muscles. The head is articulated with the atlas by two condyles: the under surface of the cranium is very flat.

There is no distinct zygomatic arch, orbit, or temporal fossa.

All round the upper jaw is a row of small pointed and vertical teeth; and in front only a small additional row before the others. The inferior jaw has a single row of teeth. Its two branches are nearly rectilinear, and make an angle of about 45°. It has no ascending branch, and the coronoid process is inconsiderable. All these parts are well ossified and firm; and, although the sutures are still visible, we cannot fail to see that the bones belong to an animal very near the adult state.

The bony apparatus of the gills is much more firm than in the firen or axolotl, and somewhat differently composed. The hyoideal branches are slender, and suspended to the sides of the cranium behind the articulation of the lower jaw. The os hyoides is short and thick, and supports behind two pieces equally short and thick, which diverge a little. The first arch of each side, which is the largest, is articulated to the extremity of one of these pieces, and has the two other arches attached to its posterior edge.

There are fifty-six vertebrae: the pelvis is attached to the thirty-first; and the twenty-five following belong to the tail. Six only of these vertebrae, beginning with the second, support rudiments of ribs, still smaller than those of the salamander and the firen.

All the vertebrae, excepting the last of the tail, are perfectly ossified: their form is peculiar to this species.

Organs of Digestion.—The tongue is short, with little power of motion in front, and supported by the anterior extremity

extremity of the os hyoides. The intestinal canal extends nearly in a straight line through the abdomen. The œsophagus is folded longitudinally; and the stomach is only a rather larger portion of the canal, not marked by any constriction. There is neither cæcum nor large intestine. An oblong liver, pointed at the two ends, of a blackish-grey colour, with two notches in its left edge, occupies about two-thirds of the length of the animal. A large gall-bladder, attached to the internal surface of the liver, pours the bile into the intestine by a short canal. The pancreas is small and narrow, and attached to the intestine opposite to the gall-bladder. An oblong narrow spleen is attached to the mesentery, and is about one-fourth of the length of the liver. The mesentery is simple, and has the usual vessels. There is no omentum.

The Organs of Circulation are the same as in the firen, except that the branchial veins unite together, to form the descending artery, rather lower down.

Organs of Respiration.—The branchiæ are moved, as in the axolotl, the firen, &c.: but no reptile has so small a proportion of lung as the proteus. There is no larynx, properly so called, only a small opening at the bottom of the pharynx, which is the entrance of a common crescent-shaped cavity, the angles of which are prolonged to form the lungs. The latter are merely two very thin membranous canals, terminated by a slight dilatation, presenting in their interior no division into cells, and exhibiting very few blood-vessels on their parietes. When we consider how little difference there is between such lungs and the forked air-bladders of some cartilaginous fishes, we can hardly help concluding that there is some analogy between the two organs.

Organs of Generation.—In the female dissected by Cuvier, oblong lobed ovaries, full of very distinct small ova, were situated towards the lower part of the abdomen, at the sides of the rectum. Very long oviducts, making several turns, like those of the salamander, ascend to the anterior third part of the cavity.

Organs of Secretion.—There are kidneys and a bladder, as in the salamanders: the former are very long, and pass high up in the abdomen.

All these observations, and particularly those concerning the osteology, make it clear that the proteus is a particular animal, different from all hitherto known: they also make it very probable that it is an adult animal, not destined to undergo any further change of state.

A proteus taken alive threw up from its stomach many shells of the genus *helix*, but it would not take these shells or any other food, and became daily more languid and weak. It seemed, when alive, very torpid, and moved but seldom; it swam, however, sometimes, with the help of its broad tail, very swiftly, in every direction. The first days it crept slowly on the bottom, and seemed to look for food; it often took a shell into its mouth, but gave it out again, swallowing none. Several times it rose to the surface, stretched its head out of the water, and took in air, but returned directly to the bottom. It uses its feet in creeping on the bottom, and in ascending along the sides of the vessel, if of wood. It creeps very slowly or deliberately, inasmuch that this motion seemed quite characteristic of the animal.

It often produces a hissing kind of noise, pretty loud, more so than one should expect from the size of the animal, and resembling that produced by drawing the piston of a syringe.

All the habits of the proteus designate a slowness and weakness agreeing very well with the excessive smallness of

its pulmonary organs, and the very inconsiderable extent of their surface.

It is a very rare animal, having been hitherto found, and that in very small numbers, only in those lakes of Carniola, which are celebrated on account of their subterranean communications and the singular phenomena which result from them. That of Cirknitz is the most famous, and is regarded as the source of all the others. According to Laurenti, the first proteus was found in this: but Schreibers allures us that it only inhabits the lake called Sitticher See, communicating with the Cirknitz; and that it is thrown out in the overflowings, which occur once or twice a-year.

Cuvier thinks it probable that its natural abode is in the subterranean communications extending from one lake to the other. It has, in fact, all the characters of a subterranean, as well as of an aquatic, animal. Its small eyes, concealed and rendered useless by an opaque skin, recall to us the blind rat (*zerni*, mus, or *spalax typhlus*) which lives under ground, and has exactly the same organization.

In a letter to Cuvier, Schreibers informed him that, since the publication of his paper in 1801, he has met with several individuals, all perfectly alike, among which he had in vain sought for one without the branchiæ. That he himself has some, which have been two years in his possession, alive and well, although they have taken no food the whole time.

For the external figure and anatomy of this animal, see the plates subjoined to Dr. Schreibers' paper in the *Phil. Transf.* and pl. 13 of the *Recueil d'Obs. de Zool. et d'Anat. Comparée de Humboldt*, v. 1.

Another of these doubtful animals has been figured in the *Annales du Muséum*, v. 10. p. 230. pl. 17. under the name of *protée*, or *salamandre tetradactyle*, by Lacépède, who has there described its external conformation. It possesses branchial appendages, eyes covered by the epidermis, and two rows of fine teeth. As only the specimen described in the above quoted work is known (without any information about the quarter whence it came), its anatomical structure has not been examined. All the appearances lead us to expect an internal organization like those of the proteus and firen.

The following are the principal sources of information on the subjects of the preceding article. Cuvier, *Leçons d'Anatomie Comparée*. Blumenbach's *Manual of Comparative Anatomy*; also his *Specimen Physiologiæ comparatæ inter Animalia calidi et frigidi sanguinis*, 4to. Goett. 1787; or in *Commentation. Soc. Reg. Scient. Goettingenf.* v. 8. Daudin, *Histoire Naturelle des Reptiles*, in the 8vo. edition of Buffon by Sonnini, 8 tomes. Brongiart, *Mémoire sur une nouvelle Classification des Reptiles*. Lacépède, *Histoire Naturelle des Quadrupèdes ovipares et des Serpens*. Latreille, *Hist. Nat. des Salamandres de France*, avec figures. Schneider, *Historia Amphibiorum*. Schoepff, *Historia Testudinum*, 4to. Schneider, *Naturgeschichte der Schildkröten*. Roefel, *Historia Ranarum*. Mémoires pour servir à l'Histoire des Animaux. Tyson's *Anatomy of a Rattlesnake*, *Phil. Transf.* v. 13. Swammerdam *Biblia Naturæ*. Charas, *Nouvelles Expériences sur la Vipère*. Caldesi, *Osservazioni Anatomiche intorno alle Tartarughe*, 4to. Hermann, *Tabulæ affinitatum Animalium*. Spallanzani's *Dissertations*. Cuvier, *Recherches sur les Reptiles douteux*, in *Humboldt, Recueils d'Observ. de Zool. et d'Anat. Comp.* v. 1. Various papers by Cuvier and Geoffroy St. Hilaire, in the *Annales du Muséum*.

REPTILES are likewise used, abusively, for plants which creep on the earth, or on other plants, as wanting strength of stalk to sustain themselves.

Such

Such are cucumbers, melons, &c. ; such also are ivy, the vine, and bryony.

REPTON, in *Geography*, a considerable town in the hundred of Repton-and-Gresley, and county of Derby, England, is situated near the banks of the river Trent, at the distance of eight miles S.W. from the town of Derby, and four N.E. from Burton-upon-Trent in Staffordshire. Among antiquaries it is celebrated as the site of the capital of the Mercian monarchy, and the burial-place of several of its sovereigns. At that period it was called Hreopandune ; and is conjectured by some to have risen upon the ruins of the Roman station Repandunum ; and the town is called Reppendune in ancient deeds. In the Saxon annals Repton is said to have been noted for a noble monastery of men and women, established, under the government of an abbeys, previous to the year 660. This abbey was destroyed by the Danes in the reign of Buthred, the last king of Mercia, and remained in a desecrated state till the year 1172, when it was refounded as a priory by Matilda, widow of Ranulph, second earl of Chester, who bestowed upon the monks the tithes of Repton, and considerable estates in the neighbourhood, besides Bartlow in Essex, and lands at Granden, in Huntingdonshire. At the dissolution its revenues were estimated at 167*l.* 18*s.* 2*d.* In the original structure were deposited the remains of several of the Mercian kings ; as were likewise those of Ryneclardus, brother to Sigebert, king of the West Saxons. Some portions of the later buildings are yet in existence, being converted into a school-house and apartments for the master and usher. The school-room, as appears from the windows and other traces, was either the refectory, or the hall, of the priory. It is supported by a row of strong round columns, with pointed arches. At the northern extremity of this room was the dormitory ; and on the east side were situated the cloisters, the area of which is now a garden. Adjoining the cloisters stood the church which Fuller, in his "Church History," describes as an elegant and spacious structure, supported in the interior by pillars of alabaster, fragments of which have been occasionally laid open. Foundations of other buildings, besides those mentioned, may still be plainly traced in various directions ; and on the site of the prior's lodging is a mansion called Old Trent, built about a century ago, which displays, towards the water, a curious brick tower with an ornamental cornice, part of a former building, erected by Prior Overton in the reign of Henry VI.

Repton consists chiefly of one street of scattered houses, extending about a mile in length, and watered by a fine stream, which discharges itself into the Trent. At the

lower end of the town stands the parish church, a large, handsome edifice, ornamented with a fine spire two hundred feet high. Tradition affirms that the present is the third church, which has occupied the same site ; and there can be no doubt that parts of it are of different and distant dates. The nave and side aisles seem to be of the reign of Edward III. ; but the chancel is probably more ancient, as its columns are massive, and its arches semicircular. Beneath this part of the church is a crypt, bearing a strong resemblance, in form and ornaments, to the crypt under Canterbury cathedral, and also to that under St. Peter's in the East, at Oxford. In the interior of this building are several handsome monuments to the memory of the Thacker family. Within a close behind the church, a labourer some years ago discovered a cemetery, which contained among many other human skeletons, one of an extraordinary size, measuring nine feet in length. This discovery is noticed by Dr. Pegge in the *Philosophical Transactions* for the year 1734. An old stone cross, consisting of a single shaft, placed upon eight octagonal steps, stands in the area fronting the church. The parish of Repton, according to the parliamentary returns of 1811, contains 326 houses, and 1648 inhabitants, who are chiefly engaged in pursuits connected with agriculture.

At a short distance from Repton is Sudbury, the seat and property of the family of Vernon, which is of great antiquity, deriving its descent from Richard de Vernon, a Norman lord, who accompanied the Conqueror to England ; and was one of the seven barons created by Hugh Lupus, the great earl of Chester. Sir Ralph de Vernon, who was alive in the reign of Edward II., is said to have reached the extraordinary age of 150 years. Sudbury church, an ancient fabric, standing in the garden near the house, is decorated with many sepulchral tombs to members of this family. One, in commemoration of Catharine, daughter to the late lord Vernon, is remarkable for the beauty of the epitaph, which was written by William Whitehead, poet-laureat.

At Egginton, on the banks of the river Dove, west of Repton, is a seat of sir Henry Every, whose family was originally seated in Somersetshire. Part of the old mansion here was destroyed by fire in the year 1736, and the present house then erected on its site.

Bretly park, the seat of the earl of Chesterfield, is about three miles S.W. of Repton. About three miles E. of Bretly is Calke hall, the seat of sir Henry Harpur, bart. The house is a spacious quadrangular edifice, seated in a park surrounded by eminences. *Beauties of England and Wales*, vol. iii. by John Britton and E. W. Brayley, 1802.

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